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THE RUDDY ECLIPSED MOON.

By Richard A. Proctor.

MR. W. MATTIEU WILLIAMS, whose views respecting the physics of astronomy have been suggestive and interesting, even where not theoretically sound, has maintained with his customary ability and liveliness the theory that the moon has a heated tufaceous surface, showing a red glow due to a temperature of about 600° Fahrenheit (*Gentleman's Magazine* for February, 1882); and he attributes to this high temperature the ruddiness of the moon at the time of total eclipse. I am not proposing to attack this theory, which seems fully entitled to die a natural death: otherwise I might point out that Prof. Langley's refined experiments with his delicate heat-measurers, indicate for the moon's surface even when she is full, or exposed to the full blaze of sunlight, a temperature many degrees below the freezing-point. I might also dwell on the circumstance that nearly three hundred years ago a black eclipse of the moon was observed by Kepler, when not a trace of the moon could be seen during part of the totality though the stars were shining in a clear sky. On three occasions since then the moon has been lost to view, even to telescopic view, at the time of mid-totality. This at any rate would dispose of that part of Mr. Williams's theory which involves the cooling down of the moon measurably within comparatively short intervals of time,—as between the eclipses of 23rd August, 1877, and December 6th, 1881. But in truth the red-hot moon theory needs no *à posteriori* attack, being altogether devitalized by *à priori* disease.

What is really worth correcting is Mr. Williams's mistaken argument respecting "the usually accepted theory of the red moon within the shadow." (Even correct theories, I may remark in passing, are usually more valuable for the facts they co-ordinate than for their own intrinsic merit,—and it may be noticed frequently that an erroneous theory does more harm through the false ideas associated with it—false ideas respecting facts—than because of its own inherent falsity.)

This "usually accepted theory" Mr. Williams evidently misunderstands. And when a man of his ability and clear-sightedness misunderstands a theory, we may take it for granted that many others must misunderstand it too. I remember that the present Astronomer Royal, in dealing with Mr. Brett's amusing theory about Venus, as a shiny metallic planet enclosed in some sort of vitreous shell showed manifest misapprehension of the way in which the refractive action of a planet's atmosphere bends the sun's rays round the planet's body, geometrically intervening between the sun and the observer on earth. We may be well assured multitudes of "general readers" err, when mathematicians and physicists—even though it be but through carelessness—go astray as Mr. Christie and Mr. Williams have done in this matter, though not both in the same way.

The usually accepted theory, says Mr. Williams, is that the illumination of the moon in shadow is due to the refraction of sunlight by the earth's atmosphere *and the transmission of the twilight of the lower atmospheric strata.* The first part of this is right, the italicised portion is altogether wrong. It is not the transmission of the twilight of the lower atmospheric strata, but of the sun's very own rays, which causes the red light of the eclipsed moon,—a very different matter. Indeed the mistake is so utter that when I first read the above sentence, I thought it was only a carelessly worded expression of the real fact. But one has only to read on to see that Mr. Williams imagines the usually accepted theory to explain the red light as due to the ruddiness pervading our atmosphere at the time of evening and morning twilight. He quotes a sentence of Sir John Herschel's in which reference is made to the tints of our glowing sunsets, a sentence which might readily mislead any one who had got hold of the erroneous idea Mr. Williams has adopted. The atmospheric strata, says Herschel, "will impart to all the rays they transmit the ruddy hue of sunset, only of *double* the depth of tint which we admire in our glowing sunsets, by reason of the rays having to traverse twice as great a thickness of atmosphere." This of course is quite correct, but Herschel is talking of the rays of the sun on their course from the sun to the moon, not of the transmission to the moon of the rays from our illuminated air. "According to this," proceeds Mr. Williams, speaking of Herschel's remark as misunderstood by him, "the eclipse of October 4 should have shown the moon as an excessively ruddy ball, for we have had excessively 'ruddy hues of sunset' all over the world of late, and on the date of this eclipse the sunset was especially magnificent, in this part at least." Of course, if the rays of the sunset skies transmitted through our air were the cause of the ruddiness of the moon, this argument would be perfectly just: but the ruddiness of our skies indicates just the reason (probably) why the moon looked so dark on October 4. As Mr. Williams himself says, in trying to explain why his red-hot moon could not show (poor thing!) on October 4, the recent sunset glows indicate the extinction of a large amount of red—"quite as much as the eclipsed moon," he proceeds, "heated to 600°, is supposed by my theory to radiate." If the sun's rays stop on their way to light up our atmosphere with an unusual amount of ruddy lustre it stands to reason they cannot get through in usual amount to light up the moon's surface during totality.

Farther on, Mr. Williams speaks of a stratum of air two miles high being all that can be illuminated by the sun's rays, and then compares the earth shine of the new moon, which is due to the light reflected by the whole surface of the earth with the sun shining fully upon it, on the one hand, with "the little burnished edge of the circular outline of the dark earth which shines upon the moon during the eclipse" on the other. It is manifest that it is *sunlit*

matter, a burnished edge, he is thinking of, not the sun himself brought into view in the form of a ring all round the earth, as is really the case. The fine ring of light, which he compares in area with the whole surface of the earth (more effectively illuminated, as he supposes) is in reality not an illuminated ring at all, but self-luminous; its brilliancy is not the same as (or, as Mr. Williams supposes, even much less than) the brightness of the sunlit earth, but hundreds of thousands of times greater. This is not a point open to doubt, and therefore requiring demonstration, though it may need (and indeed appears to need) explanation. But if proof were needed it would be found in the corresponding case of the arc of light seen round Venus during transit in 1874, and partially during the transit of 1882, when however the air of Venus would seem to have been more cloudy and less of it therefore available for the work of bending sun rays: for the arc of light left its photographic record as quickly and sharply as the light from the sun's disc, showing that it was not reflected sunlight, but the sun's own light slightly deflected only on its course.

The actual condition of things during the time of total lunar eclipse is, I find (from talking the matter over with many), very little understood. For instance many speak of a ring of light round the moon as if a total lunar eclipse were always central, which is far from being the case; or as if at any rate *some* point of the sun's face were

Fig. 1.

directly beyond the earth's centre as supposed to be seen from the moon, which again is not the case. And then the way in which different layers of our atmosphere work to raise the sun into view is not at all understood by certainly 999 out of 1,000 who have read the usual explanation of lunar eclipses. Fig. 1 represents the case of a central total eclipse—central, however, only as supposed to be seen from *a single point* on the earthward lunar face. Fig. 2 represents the case of a non-central total eclipse. In one case the sun is distorted into a uniform ring, in the other into two meniscus arcs of unequal extent, and of unequal breadth.

But let us examine the matter a little more closely.

The refractive power of our atmosphere is such that under favourable conditions the setting sun is raised about 35 minutes of arc or by more than his own diameter. Doubling this, we find the greatest amount of deflection of solar rays in passing into our earth's atmosphere and out of it, on its way towards the moon, to be about 70′ of arc. Now the earth as seen from the moon appears nearly two degrees, or more exactly, about $1\frac{9}{10}$ deg. in width. So that if the sun were a bright point just beyond the earth's centre, as looked at from the moon, he would only require to have his rays bent round $\frac{1}{2}\frac{9}{0}$ths of a degree, or 57′, to be seen as a ring all round the earth. With the actual deflecting power of the earth's atmosphere, he would be more than sufficiently lifted into view, which means that instead of appearing as a ring just touching the earth's edge, he would appear as a ring slightly separated from the edge of the earth's disc.

Appearing really as a disc, 32 minutes of arc in diameter, as seen from the moon's distance, the sun when centrally behind the earth as in Fig. 1, would come within 41 minutes (57 less 16) of the earth's edge, all round—that is the distances S *s*, S′ *s*′, would all be 41 min. The earth's air would lift the sun then well into view. But not only so, parts *beyond* the centre, so to speak, would be lifted into view. A point as A, on C S′ for example, would be lifted into view not only towards *s*′ but towards *s*. This would happen close up to S′, though S′ itself, being 73 minutes (57 plus 16) from *s*, would not be lifted into view near *s*,—at least not usually. When the earth is at her farthest from the moon so as to look smallest, and the sun at his nearest so as

Fig. 2.

to look largest (as at or about Jan. 1) S′ would be brought into view towards *s* as well as towards *s*′; only at *s* this point of the sun would be seen on the very verge of the earth's disc, while at *s*′ it would be raised above the earth's edge.

Usually, all the points along a line S C A of the sun's face (A close to S′) would be brought into view at *s*, in the form of a very short line *s a*, extending from the earth's edge at *a* to a height of perhaps about $2\frac{1}{2}$ miles. (The height of the point *s* would be determined as that at which the atmosphere would have power to deflect the sun's rays 41 minutes, or when the horizontal refraction would be about $20\frac{1}{2}$ minutes. I know of no experimentally-obtained formula—and no other would be trustworthy—which would show at what height above the earth's surface the sun on the celestial horizon would be raised any given amount by refraction.) A line as B S′ on the sun's face would be seen

in the form of a line b S′ on the earth's edge. The part B A would be seen on both sides of the earth.

As this holds for every diameter of the sun's face, it follows that the ring seen round the sun would be a very singularly distorted image of the sun; one may say there would be two images of the sun. Outside the circle into which the point C would be transformed, a circle very close to the earth's edge, there would be an image of the sun in the form of a ring, such as would be produced if a bright circle were divided into an infinite number of sectors, and each were carried a considerable distance (the same for each) radially from the centre, all of them shortening equally as they retreated, and also widening so as to form a complete ring. *Inside* the circle into which C would be transformed, there would be another circular image of the part of the sun inside the dotted circle A B D E, a ring image such as would be produced if a bright circle were divided into an infinite number of sectors, and each were carried a considerable distance (the same for each) radially across and *then from* the centre, so that they would go to the opposite sides from that which they had before occupied, shortening and widening as they went, so as to form a complete ring.

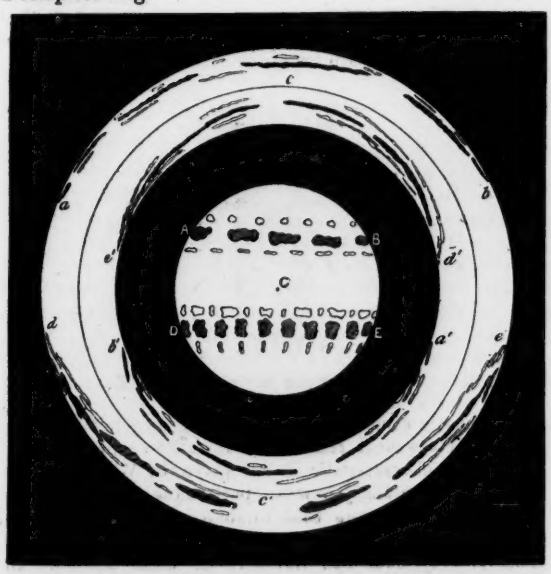


Fig. 3.—Illustrating the distortion of the sun's face, around the disc of the earth, as supposed to be observed at the time of central total lunar eclipse from the moon.

An idea of the actual distortion of the solar disc in this way (in the case where the eclipse is central and the whole breadth of the sun is supposed to be just lifted into view all round) may be conveniently obtained from Fig. 3. Here A B E D is supposed to represent the sun's disc, A B, D E the spot zones, P Q the outline of the earth's disc; and the ring-shaped double image of the sun formed around the earth is supposed to be enormously exaggerated in width, so as to form the double ring $a\,b\,e\,d\;a'\,b'\,e'\,d'$, $c\,c'$ representing the circle into which the centre C of the sun's face is altered. If we imagine the double-ring image compressed into the form of a very narrow ring of uniform width, the true nature of the distortion of the solar image would be represented. The row of large spots A B (purely imaginary, of course) is altered into the arc $a\,b$ on the outer part of the ring, and into the arc $a'\,b'$ on the inner part, while the row D E is altered into the arc $d\,e$ on the outer half and into the arc $d'\,e'$ on the inner half.

The distortion where the eclipse is not central is different. In such a case as is illustrated in Fig. 2, there is a complete image of the sun as at $k\,s\,k'\,s'$ (the points thus marked corresponding to the points K S K′ S′ of the solar disc) on one side of the earth; while on the opposite side there is an image $l\,s'\,l'\,b$ of the portion L S′ L′ B′ of the sun's face. Of course the breadth of these distorted images is considerably exaggerated.

The student will find it a useful exercise to indicate the distortions corresponding to other cases, as when the central point C falls within S K K′ but not centrally, at C′. So the case corresponding to the transit of Venus or Mercury, where the disc of the planet is small compared with that of the sun, will be found interesting to deal with. Hereafter I may consider transits of Venus and Mercury in a separate paper.

It remains only to consider how much light may reach the moon in this way during central totality.

Taking $2\frac{1}{2}$ miles as the probable extreme height of the parts of the atmosphere effective in lifting the sun into view (that is, supposing $a\,s$, $b\,s'$, in Fig. 1 severally equal to $2\frac{1}{2}$ miles) and further supposing the air as clear as possible, and free from cloud or dust, we may perhaps assume the intensity of sunlight reduced no more than one-half by atmospheric absorption. By this I mean that the average absorption for the ring $s\,e\,s'\,d$ (Fig. 1) is one-half. In this case, we should get the maximum amount of illumination. We have only to compare, then, the apparent area of the ring $s\,d\,s'\,d'$ with the apparent area of the sun, and to take this absorption into account to be able at once to determine how much light the moon can receive at a point on her surface where the eclipse is absolutely central. At other points of course she will (under similar conditions) receive more light.

Now remembering that C a (Fig. 1) represents 57′, and C S 16′, we have, since $a\,s = 2\frac{1}{2} \div 3960$ C a.

$$\text{ring } s\,e\,s'\,d' : \text{disc S S}' :: 2\pi\,57 \times \frac{5}{2 \times 3960} : \pi\,(16)^2$$
$$:: 285 : 3960 \times 256$$

or light from

$$s\,e\,s'\,d' : \text{full sunlight} :: 570 : 3960 \times 256$$
$$:: 57 : 399 \times 254 \text{ approximately.}$$
$$:: 1 : 1778$$

Supposing the air so far wanting in clearness that the average brightness of $s\,e\,s'\,d'$ was but the twentieth of sunlight, the minimum illumination of the moon's disc would be still one-17,780th of sunlight illumination. Now if the earth's *albedo* or light-reflecting power is about the same as the moon's, which may fairly be assumed, then her light when full in the moon's skies, as when she is illuminating that part of the new moon which is sometimes called "the old moon in the new moon's arms," is about one-46,000th part of sunlight, or less than one-third the light illuminating the moon's surface during total eclipse if the earth's air absorbs nineteen-twentieths of the sun's light, and less than one thirtieth of that light if the air absorbs (on the average) one half of the sun's light. It must be remembered too that we have comparatively imperfect means of measuring the amount of light coming from the earth-illuminated parts of the new moon, the contrast with the sun-illuminated part being so great. During partial lunar eclipse the earth's shadow looks very much darker than when totality has begun, and the contrast with the uneclipsed parts no longer deceives the eye.

Of course, if there are cloud banks round any part of the circumference $a\,d\,b\,e$, Fig. 1, the illumination of the ring $s\,e\,s'\,d$ is correspondingly reduced,—as indeed the area of this ring is reduced. If there were conceivably clouds

floating 2½ miles above the earth's surface over the whole zone foreshortened into the circumference *a e b d* the sun's light would be wholly lost. Something like this must have been the state of things when Kepler, Wollaston, and others saw the dark lunar eclipses which have been recorded by them. It is easily seen that the range of possible illumination varies from absolute darkness to some thirty times full earthlight, or more than 400 times full moonlight. Possibly taking into account the circumstance that there is only one point on the moon's disc where the eclipse is absolutely central, we may get, under very favourable conditions, 500 times full moonlight from a (so-called) totally eclipsed moon.

Since the above paper was begun, several weeks since, I have observed that Mr. Baxendell has endorsed (at a meeting of the Astronomical Society of Liverpool) Mr. Williams's mistake.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

THOUGH *Xestobium tessellatum* is the principal beetle which, in this country, has been identified with Death-watch tickings, it is not alone in this claim to the character of harbinger of death; *Anobium domesticum* also ticks, and has, no doubt, scared many a rustic equally with *Xestobium*. One entomologist, at least—the indefatigable Professor Westwood—once kept a regular diary of its tickings, the particular specimens whose doings were chronicled being inhabitants of a wooden mantel in the Professor's study; they ticked at intervals during the winter months as well as at other seasons, though at such times the noises could scarcely have been intended, as they probably are during the warmer months, as an exchange of compliments between love-sick couples.

Notwithstanding the obscurity and retirement of their life, these wood-boring beetles have not managed to escape the attacks of parasites. Several species of ichneumon flies and other allied insects prey upon them, and the delicate little gauzy-winged persecutors may sometimes be seen running about hither and thither over Anobium-infested wood, in maternal anxiety to find a suitable *nidus* for their brood. Some, too large to enter the burrows, are furnished with a long ovipositor with which to reach their victims, into whose bodies they insert their eggs. Others are small enough to enter the burrows bodily, and hunt their prey like a ferret after a rabbit. One of these latter, *Theocolax formiciformis*, superficially something like a minute ant, in consequence of the absence of wings, I have obtained in considerable numbers from a colony of *Anobium domesticum* which had established themselves in an old aquarium stand.

Yet another member of this family of wood-borers, of very similar appearance to Anobium, sometimes does considerable damage to woodwork. It is especially partial to willow-wood, in which it makes neat cylindrical burrows. It is called *Ptilinus pectinicornis* (Fig. 1), and the specific name refers to a remarkable peculiarity in the antennæ of the male, the sex which, for a reason that will appear presently, is most commonly seen. It may be recognised by its extremely cylindrical reddish-brown body and rather swollen black thorax. The antennæ are marvellously beautiful; instead of being composed of a mere string of simple joints, such as constitute those of the allied species, and, in fact, of beetles in general, they appear, when fully spread out, like two pieces of deep fringe. This results from each joint, except the two at the base and the one at the apex, carrying a lateral appendage generally far longer than itself. The apical joint is itself of the same form as these appendages, so that altogether there are nine of them; but the one nearest the base is much shorter than the rest, and seems little more than like a stout tooth, while the last seven, which are of nearly equal length, are several times as long as the joints to which they belong. Antennæ of a similar character occur in a few other British beetles, though in none is the peculiarity so greatly exaggerated as in the present species.

It is not easy to conjecture the *raison d'être* of this remarkable feature, for there seems to be little in the habits of the insect to account for its differing from its congeners in so peculiar a way. It can scarcely be merely a sexual distinction, but seems to point to some greater acuteness in the organs of sense, perhaps necessitated by the fact that the female rarely leaves her burrows, only advancing to the entrance thereof to receive the addresses of her lord and master, who, on his part, remains on the outside, and conducts his courtship from that position. It is a curious fact that the males of certain moths, which have similarly complex antennæ, possess also a marvellous power, quite independent of sight, of detecting, even from great distances, the presence of a virgin female of their own species.

Fig. 1. Ptilinus pectinicornis (male).

Ptilinus is sometimes terribly destructive to timber, and apparently the most remarkable instance on record of this undesirable characteristic is one given by Westwood, who states that a perfectly new bed-post (those were the days of the great four-posters that lumbered up our fathers' bedchambers) was, in the space of three years, completely destroyed by countless numbers of these insects. But such depredations are necessarily becoming more and more things of the past, and in these days of iron bedsteads, &c., *Ptilinus*, and others of that ilk, must be beginning to find that they have fallen on evil times, and that the conditions of life are not nearly so favourable as they used to be in the happy days of old. I have found it also in a printing-office, where, in the abundance of wooden "plant" stored up, it must have discovered a perfect mine of wealth.

Anobium domesticum is not the only representative of *that* genus in our household fauna; another is *A. paniceum*, a shorter and broader insect of somewhat paler colour. It is almost omnivorous in its tastes, attacking any sort of vegetable substance that may fall in its way, though less of a wood-borer than its relative; such things as dry bread, biscuits, rhubarb root, ginger, wafers, and even so unlikely a substance as Cayenne pepper, have been greedily devoured by it, and it has also not unfrequently attacked ship's biscuits, riddling them through and through, and damaging them to such an extent as to render them quite unfit for human food. Nor does it make any difference if the vegetable matter is not in its primitive con-

dition, but has had its character so much altered as is involved in having passed several times through the hands of the manufacturer; thus, paper will furnish it with an enjoyable meal, and books even yield it *physical* sustenance. A curious case of the latter is recorded of either this insect or some closely-allied species; twenty-seven folio volumes in a public library were perforated in a straight line by one and the same insect, and so regular was the tunnel that a string could be passed through the whole length of it, and the entire set of books lifted up at once thereby—a tolerably clear proof that the library, or, at any rate, that particular portion of it, could not have been in great request with *human* bookworms, or the *insect* ditto would scarcely have found its course so entirely unimpeded.

Drawings, and even paintings, have also been destroyed by this insect, and on one occasion it invaded the sacred seats of learning and made away with some Arabic manuscripts in a library at Cambridge, and at another time wrought havoc in the herbarium of a botanist. The powerful jaws of the larva, too, are not deterred even by a thin coating of metal, for Westwood records having seen tinfoil perforated by it, no doubt for the purpose of pilfering some treasure contained beneath.

So, while *A. domesticum* destroys chairs, tables, picture-frames, cupboards, floors, &c., and sometimes terrifies nervous old ladies by its ticking, its relative *A. paniceum* attacks the stores of comestibles, works of art, and literature of the dwelling, and between them they would, in the course of time, if unchecked, produce terrible ruin. When found in woodwork out of doors, the direct damage insects of this kind do by the actual excavation and devouring of the wood is not the only injury for which they are responsible; for damp air enters the substance of the wood through the burrows, and meeting with the excrement which is stored in great quantities in the burrows, renders it a good basis for the growth of microscopic fungi, whereby the decay of the wood is accelerated.

(*To be continued.*)

THE EVOLUTION OF THE SENSE OF BEAUTY.

By Constance C. W. Naden.

(*Continued from p. 309.*)

OUR inquiry into the origin of the love for brilliant hues and varied contours receives a partial answer from the obvious utility of the sense of colour, and still more of the sense of form. Mr. Grant Allen shows that the colour sense in insects has probably been developed in connection with the flowers on which they feed, while that of birds and of mammals has similarly been developed in connection with fruits, and that in both cases the faculty thus evolved has been secondarily applied in the selection of gaily-coloured partners. "If," he says, "the eyes of insects were capable of distinguishing these bright colours, in however imperfect a degree, it would naturally follow that the hues would go on deepening from generation to generation among the plants, while the perception would go on sharpening itself from generation to generation among the insects. For while the flowers which thus become more and more readily distinguishable by their fertilisers would thereby better secure the chance of descendants, the insects which most readily distinguished flowers would thereby secure for themselves the greatest amount of the available food-stores."* Similar reasoning may be applied in the case of birds which live on fruits and on resplendent insects, and the same nerve-structure which enables a bird or butterfly to discern the colour of its food, will, of course, enable it to discern the colour of its mate. It is further shown that the most brilliantly-coloured animals, as butterflies, rose-beetles, humming-birds, barbets, parrots, macaws, toucans, fruit-pigeons, frugivorous lizards and quadrumana, are those which live on the most brilliantly-coloured food, while, conversely, carrion-feeders and nocturnal and carnivorous animals are generally dull of hue.

But all this, as Mr. Allen points out, does not in any way explain the *love* of colour, neither, I may add, do the very evident advantages of a clear discrimination of form explain the love of special shapes.*

We must leave the track which we have hitherto followed, and look a little deeper for our explanation. It is a well-known physiological fact that the normal—that is, the natural and healthy—exercise of any function is pleasurable.† It is naturally pleasant to the eye to look, to the ear to hear; except when the sights or sounds presented are in some way immediately harmful, and therefore painful. Even were this not an induction, we might deduce it from the theory of natural selection. An animal which found its vital activities irksome would soon succumb to more energetic congeners. To say that any being would rather not see, or hear, or smell, or taste, or touch, or feel, or think, is practically to say that it would rather not *live*, and, consequently, that it would not be likely to take very efficient measures to keep itself alive. The survivors, then, will generally be those which not only have the greatest fulness of life, but also the greatest enjoyment of life; and both endowments will usually be transmitted to the offspring. Hence we may conclude that so long as no direct pain, and no inherited or personal experience, testifies against a sound or sight, it will be more or less agreeable to a healthy organ. Till proved guilty, it is not only innocent, but welcome.

Since exercise is in itself a gratification, the amount of gratification will, within certain limits, depend on the amount of exercise, and therefore upon the strength of the stimulus. These limits are reached when the organ begins to feel fatigued; that is, when it gives warning that it is unable to do very much more work, and asks for a holiday. This happens when the waste of tissue exceeds the immediate repairing power. The greatest pleasure is therefore derived from the maximum of activity with the minimum of fatigue.‡

This depends upon two conditions. First, the stimuli must be *varied*. They must appeal either to different organs, or to different parts of the same organ, so that one part may not suffer from weariness while another suffers from inertia. When one set of cells has for the time outworn its power of enjoyment, another set must be called into play fresh from its sleep, exquisitively sensitive, and eager to spend its accumulated energies.

* "The Colour-sense: its Origin and Development," p. 46.

* Perhaps I may say that the next few paragraphs were written before I had read Mr. Grant Allen's "Physiological Æsthetics," and that, when I did read the book, I was pleased to find that I had hit upon a similar line of argument, and, in one case, upon nearly the same formula.

† I do not except even the functions of those organs, or parts of organs, which do not receive afferent fibres from the cerebro-spinal system. Normal secretions, digestion, circulation, and respiration, though not distinguishably pleasurable, unite to produce that state of *bien-aise* known as good health; which is, as it were, the background and matrix of all other pleasures.

‡ Mr. Allen's formula is "the maximum of *stimulation* with the minimum of fatigue." This, however, seems open to objection, since activity and the consequent enjoyment do not always increase directly with the stimulus.

XUM

The second condition of easy action is *smoothness* or continuity. A rapid succession of stoppages and renewals in the activity of any organ, caused by the quick withdrawal and return of its appropriate stimulus, is unpleasant, because the organ is constantly trying to accommodate itself to altered circumstances, and never has time allowed it for complete fruition. This second condition should be carefully remembered, because it is the basis of some of my future arguments.*

We can now see that the love for light and colour is not a product of natural selection, though without natural selection it could not have been perpetuated. The first animal which developed a dim colour-perception would from the outset find pleasure in exercising the new faculty. As the animal grew and throve, the multifarious stimuli conveyed to it from the external world would incline it to free exercise of all its parts; and any slightly excessive exercise of the dawning sense would bring a larger supply of nutriment to the new and as yet unstable organ, tending to improve and to diversify its structure, and to make it better able, and therefore more ready, to perform and to vary its functions. Increase in efficiency would mean increase of pleasure, and the pleasure, by inducing greater exertion, would in its turn promote efficiency. Such evolution could, of course, not take place (at least in these early stages) unless the added sense were more or less serviceable to the organism. But manifestations similar to those which we associate with the pleasures of vivid sensation are observed in some creatures which we can scarcely credit with consciousness. The *objective*—that is, the physical—side of the process is present; but the subjective—that is, the mental—has yet to be developed. Mr. Romanes† tells us that the tiny Englena Viridis—a mere speck of jelly—"definitely seeks the light. It prefers the blue rays [probably because, for some unknown reason, they act upon it more strongly than the other rays of the spectrum]. A colourless and transparent area of protoplasm in the interior part of its body is the most sensitive." Actual organs of sight first occur in the medusæ, which "seek the light following a lantern moved round a bell-jar containing them in a dark room," while "starfish and eclimi crawl towards and remain in the light, even though of such feeble intensity as scarcely to be perceptible to human eyes." Yet, whatever may be said of medusæ and starfish, it is difficult to credit our little Englena with what is usually called *sensation*.

Here, then, we have to state our law a little differently, substituting "well-being" for "pleasure," and "waste" for "fatigue." The greatest well-being is derived from the maximum of activity with the minimum of waste. The vigorous discharge of any function, when not carried to great excess, reacts beneficially on the organism as a whole. Therefore, those organisms which court varied stimulation are the most likely, other things being equal, to survive and to replenish the earth.

As we ascend in the scale of existence, consciousness emerges, and this well-being is translated into its subjective correlate—pleasure. Flies and moths even commit suicide from sheer love of light. Bees, as we have seen, are mercenary in their fondness for colours; but this cupboard-love is probably mingled with a purer passion. Sir J. Lubbock finds that they chiefly affect orange and yellow, and that they like blue next best. It is in birds, however, that we have the first trace of something like human æstheticism.

(To be continued.)

* It is, indeed, the chief point in which my theory differs from that of Mr. Allen.

† "Mental Evolution in Animals."

THE YOUNG ELECTRICIAN.

By W. Slingo.

(*Continued from p.* 303.)

TAPPING.

Ex. XLIX.—One of the most essential, and withal one of the simplest, processes in the manipulation of tools is that of "tapping" or preparing a female or internal thread into which a screw is to be driven. In order to tap successfully, attention to a few precautions, insignificant as they may at first sight appear, is absolutely necessary.

In the first place a hole must be bored by means of a drill (Ex. XXIX., &c.) in the piece of metal to be tapped, the size of the hole being equal to that of the tap at the bottom of the thread; that is to say, if the tap were deprived of its threads, the remaining piece of wire should just pass into or through the hole. This is most important, as, if the hole is too small, the tap, in forcing its way through, has to remove more metal than would be involved in simply cutting the thread. The consequence of throwing such work upon the tap is frequently a fracture, due to the torsion exerted. On the other hand, if the hole is made too large, there is not sufficient metal to give a fully-formed thread.

The hole being duly made, proceed to tap it. Hold the tap firmly between the jaws of a hand-vice (Ex. XXVIII.) (the tap being provided with a flat end for that purpose), and screw it gently and carefully into the hole. As in making the tap, so in using it to tap a hole, the tool should be turned only so long as it progresses with a moderate degree of freedom. When resistance to the forward motion is experienced, the tap should be turned backwards slightly to relieve the strain exerted upon it, and the forward movement then repeated, this being continued until the entire thread is produced. It is imperative that the axis of the tap should correspond with the axis of the hole. The result of failing to secure this is that, supposing a flat-headed screw to be subsequently driven into the hole, it will not go right home, one side only of the head being able to come into contact with the metal.

So far as concerns the fixing of the work to be tapped, it may be secured in the table-vice (Ex. XXVI.), but it will often be found preferable to hold it in the left hand, the tap being worked with the right hand.

When tapping a deep hole bored only a part of the way through a piece of metal, the tap should be removed occasionally, and such cuttings as may be in the hole removed. Care is necessary to avoid driving the tap too far into such a hole; it should never be allowed to jamb against the bottom of the hole, or it will stand a good chance of being broken, and that would not be the worst part of the mischief, for the lower portion of the tool would be left in the hole and the work probably spoiled.

A HOME-MADE SCREW-PLATE.

Beginners often experience considerable inconvenience, or, rather, annoyance, in using the screw-plate for the preparation of screws. This want of practice often results in the breakage of a screw under manufacture in the screw-plate, whereby the plate is more often than not rendered subsequently useless so far as that hole is concerned. At the best, such a trouble must seriously injure the plate. It is advisable, therefore, the taps having been once made, to use the plate as a standard, and with the taps to prepare other plates for general use.

Ex. L.—A simple form of home-made screw-plate is

shown in Fig. 22, which will be found to have certain advantages over the ordinary plate, amongst them being the fact that the dimensions of the screw may be accurately obtained; the smooth hole near one end of the plate being equal to the size of the screw at the top of the thread; and the smooth hole at the other end, equal to the size at the bottom of the thread; the two side holes are provided with cutting edges (Ex. XLIV.) and threads of which the other two holes are the dimensions. The use of such an arrangement is that with the aid of the larger smooth hole the wire from which the screw is to be made may be of exactly the proper gauge, this hole affording also a ready means for ascertaining which is exactly the right tap (so far as its diameter is concerned) to be employed for producing the corresponding female thread. This hole offers a further advantage, inasmuch as it enables one to determine the accurate dimensions of the drill necessary to provide smooth holes through which it may be necessary to pass the screw. The small hole affords an opportunity for measuring the size of the drill to be employed in making the hole which is to be provided with the thread.

To make this convenient little plate, procure a piece of bar steel, about three-eighths or half-an-inch wide, and an eighth-of-an-inch thick. With the aid of a three-square or half-round file, cut off a piece two inches or thereabouts in length (Ex. XXIV.). In the event of such a piece of metal not being at hand, an old flat file of approximately similar

Fig. 22.

dimensions may be used instead, first softening it by carefully and uniformly heating it to a cherry red, then placing it in a quantity of hot ashes and leaving it there until practically cold. When softened it may be cut to the required size, and the holes drilled in positions as shown in

Fig. 23.

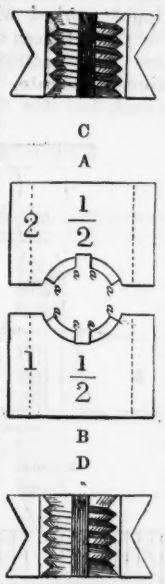


Fig. 24.

the illustration (Fig. 22). The requisite diameter of the smaller hole may be determined by passing a drill or a piece of wire through the hole in the standard screw-plate. The diameter to be given to the larger hole may be determined by measuring the external diameter of the corresponding tap with a pair of callipers (see next article), or by cutting a notch in a piece of sheet-metal just large enough to admit the thread of the tap. These measurements, of course, give the width of the blade of the drills to be employed for boring the holes. The drill used for boring the smaller hole must also be employed for boring the two side holes, the thread being produced by the tap, and the cutting edges by a three-square file. Prior to making the cutting edges, the burr which will have been produced by the tap on each face of the plate, should be removed by means of a gentle application of a comparatively large blade drill. It is possible that the file in producing the cutting edges may leave them somewhat ragged. This must be overcome by passing the tap through the hole *gently*. It would be well before doing this to smooth down the groove produced by the above-mentioned file by means of another of a very fine cut. The face of the plate may then be smoothed by means of a fine file. The screw-plate being thus completed only requires hardening (Ex. XXX.) and tempering to a *light* straw colour (Ex. XXXI.).

SMALL DIE STOCK.

Up to a certain point—say for screws of an eighth of an inch in diameter — the screwplate is all that could be desired, or nearly so. It is to be noticed that the metal from which a screw is being made is strained and squeezed in the formation, resulting in *slightly* stretching the thread, and so increasing the pitch. Again, where long screws are being made, they are apt to be bent to a greater or less extent. So far, however, as we shall require it, the screw plate will answer our purpose (Ex. XLI.). Another method for making fine threaded screws, and one which we shall have to resort to when making screws of more than an eighth of an inch in diameter, is to employ a "die stock" and "dies" (Figs. 23 and 24). The stock consists of an iron frame provided at one end with a fixed handle. At the other end is a long thumbscrew which passes through the frame projecting inwards.

The inner portion of the frame demands a little consideration, so far as its longer sides are concerned. For a short distance at the end, near the screw, these sides are flat, but for the remainder of the distance they are provided with bevelled extensions—that is to say, there are two longitudinal faces, making an angle of about 120° with each other, and 30° with what would otherwise be the flat inner side, of the frame. In this way two solid V-shaped guides are produced, the use for which we shall see in discussing dies. In Fig. 24, A and B, and C and D are plans and elevations respectively of a pair of dies, which are pieces of steel furnished with cutting edges and thread for making screws. The V-shaped sides shown in A and B afford a ready for securing the dies in the stock. They are introduced by first withdrawing the thumb-screw, so as to allow them to effect an entrance, when they are pushed along the V-guides, and the thumb-screw driven in to the requisite distance. In the form of apparatus shown (Fig. 23) there are dies of various sizes, and each piece of steel (excepting the two end pieces) is provided with two different-sized threads.

Our remarks on dies and stocks must, for want of space, be for the present suspended, but we shall find occasion for somewhat considerable amplification at the next opportunity.

CRITICAL METHODS OF DETECTING ERRORS IN PLANE SURFACES.

By John A. Brashear.

(*Continued from p. 329.*)

NOTWITHSTANDING these defects of the two systems I have mentioned, in the hands of the practical workmen, they are productive of very good results, and very many excellent surfaces have been made by their use, and we are not justified in ignoring them, because they are the stepping-stones to lead us on to better ones. In my early work Dr. Draper suggested a very excellent plan for testing a flat surface, which I will briefly describe. It is a well-known truth that if an artificial star is placed in the exact centre of curvature of a truly spherical mirror, and an eye-piece be used to examine the image close beside the source of light, that the star will be sharply defined and will bear very high magnification. If the eye-piece is now

drawn toward the observer the star-disc begins to expand, and if the mirror be a truly spherical one the expanded disc will be equally illuminated, except the outer edge, which usually shows two or more light and dark rings due to diffraction, as already explained. Now, if we push the eye-piece toward the mirror the same distance on the opposite side of the true focal plane, precisely the same appearance will be noted in the expanded star disc. If we now place our plane surface anywhere in the path of the rays from the great mirror, we should have identically the same phenomena repeated. Of course it is presumed and is necessary that the plane mirror shall be much less in area than the spherical mirror, else the beam of light from the artificial star will be shut off, yet I may here say that any one part of a truly spherical mirror will act just as

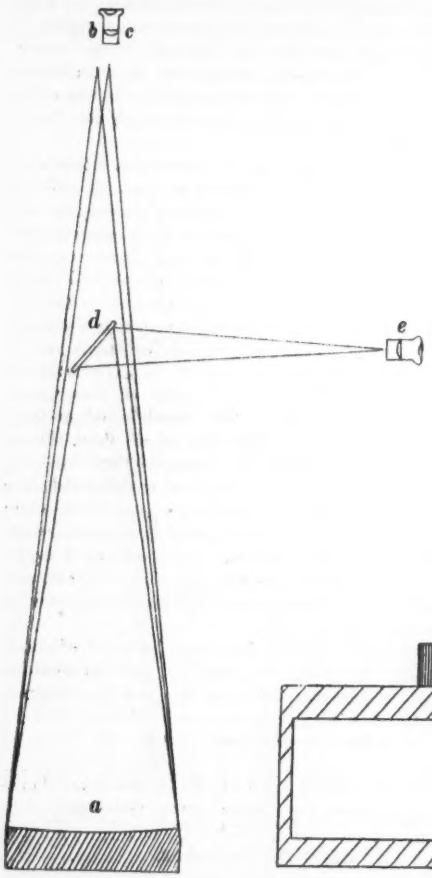


Fig. 3.

well as the whole surface, there being of course a loss of light according to the area of the mirror shut off. This principle is illustrated in Fig. 3, where *a* is the spherical mirror, *b* the source of light, *c* the eye-piece as used when the plane is not interposed, *d* the plane introduced into the path at an angle of 45° to the central beam, and *e* the position of eye-piece when used with the plane. When the plane is not in the way, the converging beam goes back to the eye-piece, *c*. When the plane, *d*, is introduced the beam is turned at a right angle, and, if it is a perfect surface, not only does the focal plane remain exactly of the same length, but the expanded star-discs are similar on either side of the focal plane. I might go on to elaborate this method to show how it may be made still more exact, but as it will come under the discussion of spherical surfaces I will leave it for the present. Unfortunately for this process, it demands a large truly spherical surface, which is just as difficult of attainment as any form of regular surface. We come now to an instrument that does not depend upon optical means for detecting errors of surface, namely the spherometer, which, as the name would indicate, means sphere measure; but it is about as well adapted for plane as it is for spherical work, and Professor Harkness has been using one for some time past in determining the errors of the plane mirrors used in the transit of Venus photographic instruments. At the meeting of the American Association of Science in Philadelphia there was quite a discussion as to the relative merits of the spherometer test, and another form which I shall presently mention, Professor Harkness claiming that he could, by the use of the spherometer, detect errors bordering closely on one-five-hundred-thousandth of an inch. Some physicists express doubt on this, but Professor Harkness has no doubt worked with very sensitive instruments and over very small areas at one time. I have not had occasion to use this instrument in my own work, as a more simple, delicate, and efficient method was at my command, but for the measurement of convex surfaces I

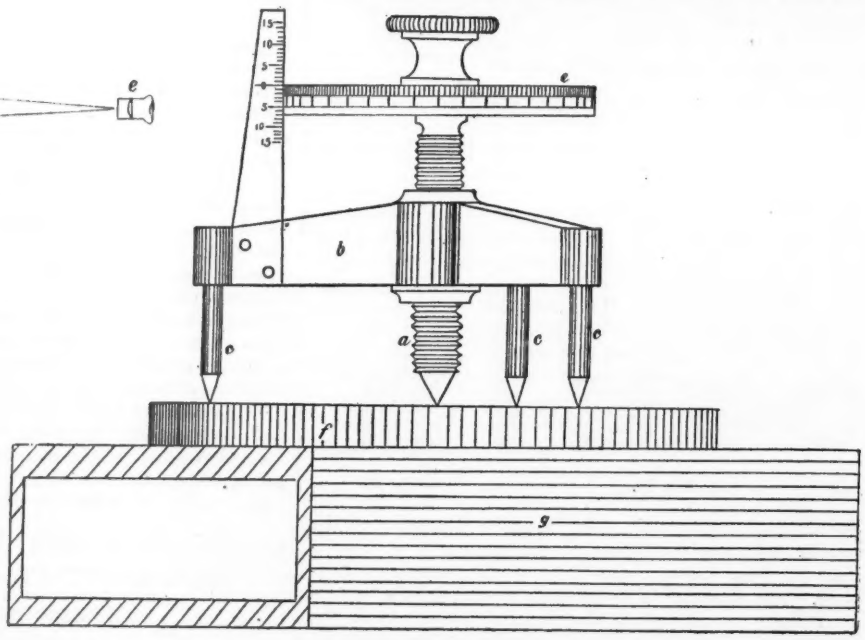


Fig. 4.

know of nothing that can take its place. I will briefly describe the method of using it. The usual form of the instrument is shown in Fig. 4; *a* is a steel screw working in the nut of the stout tripod frame *b*; *c c c* are three legs with carefully prepared points; *d* is a divided standard to read the whole number of revolutions of the screw *a*, the edge of which also serves the purpose of a pointer to read off the division on the top of the milled head *e*. Still further refinement may be had by placing a vernier here. To measure a plane or curved surface with this instrument, a perfect plane or perfect spherical surface of known radius must be

used to determine the zero point of the division. Taking for granted that we have this standard plate, the spherometer is placed upon it, and the readings of the divided head and indicator *d* noted when the point of the screw *a* just touches the surface *f*. Herein, however, lies the great difficulty in using this instrument—*i.e.*, to know the exact instant of contact of the point of screw *a* on the surface *f*. Many devices have been added to the spherometer to make it as sensitive as possible, such as the contact level, the electric contact, and the compound lever contact. The latter is probably the best, and is made essentially as in Fig. 5. I am indebted for this plan to Dr. Alfred Mayer. As in the previous figure, *a* is the screw; this screw is bored out and a

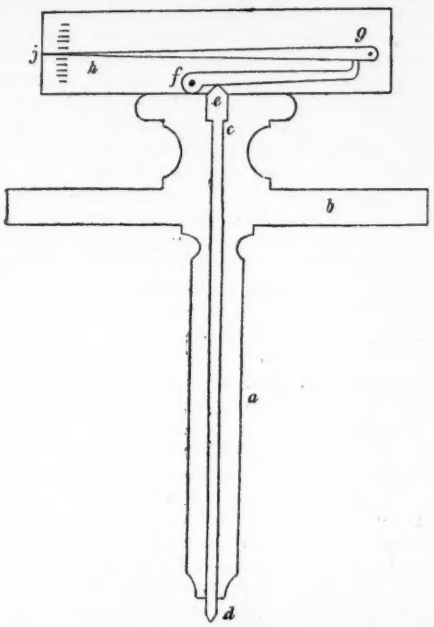


Fig. 5.

central steel pin turned to fit resting on a shoulder at *c*. The end *d* projects below the screw *a* and the end *e* projects above the milled head and the knife edge or pivot point rests against the lever *f*, which in turn rests against the long lever *g*, the point *h* of which moves along the division at *j*. It is evident that if the point of the pin just touches the plate, no movement of the index lever *g* will be seen; but, if any pressure be applied, the lever will move through a multiplied arc, owing to the short fulcri of the two levers. Notwithstanding all these precautions, we must also take into account the flexure of the material, the elasticity of the points of contact, and other idiosyncrasies, and you can readily see that practice alone in an instrument so delicate will bring about the very best results. Dr. Alfred Mayer's method of getting over the great difficulty of knowing when all four points are in contact is quite simple. The standard plate is set on the box *g*, Fig. 4, which acts as a resonator. The screw *a* is brought down until it touches the plate. When the pressure of the screw is enough to lift off either or all of the legs, and the plate is gently tapped with the finger, a *rattle* is heard, which is the tell-tale of imperfect contact of all the points. The screw is now reversed gently and slowly until the *moment* the rattle ceases, and then the reading is taken. Here the sense of hearing is brought into play. This is also the case when the electric contact is used. This is so arranged that the instant of touching of the point of screw *a*, completes the electric circuit in which an electromagnet of short thick wire is placed. At the moment of contact, or perhaps a little before contact, the bell rings and the turning of the screw must be instantly stopped. Here are several elements that must be remembered. First, it takes time to set the bell ringing, time for the sound to pass to the ear, time for the sensation to be carried to the brain, time for the brain to send word to the hand to cease turning the screw, and if you please, it takes time for the hand to stop. You may say, of what use are such refinements? I may reply, what use is there in trying to do anything the very best it can be done. If our investigation of Nature's profound mysteries can be partially solved with good instrumental means, what is the result if we have better ones placed in our hands; and what, we ask, if the *best* are given to the physicist? We have only to compare the telescope of Galileo, the prism of Newton, the pile of Volta, and what was done with them, to the marvellous work of the telescope, the spectroscope, and dynamo of to-day. But I must proceed. It will be recognised that in working with the spherometer only the points in actual contact can be measured at one time, for you may see by Fig. 6 that the four points

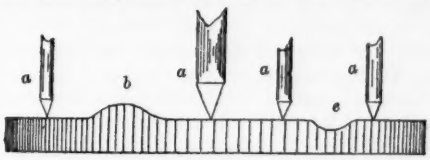


Fig. 6.

a a a a may all be normal to a true plane, and yet errors of depression as at *e*, or elevation as at *b*, exist between them, so that the instrument must be used over every available part of the surface if it is to be tested rigorously. As to how exact this method is I cannot say from actual experience, as in my work I have had recourse to other methods that I shall describe. I have already quoted you the words of Professor Harkness. Dr. Hastings, whose practical as well as theoretical knowledge is of the most critical character, tells me that he considers it quite easy to measure to $\frac{1}{80000}$ of an inch with the ordinary form of instrument. Here is a very fine spherometer that Dr. Hastings works with from time to time, and which he calls his standard spherometer. It is delicately made, its screw being 50 to the inch, or more exactly 0·01998 inch, or within 2·100,000 of being 1·50 of an inch pitch. The principal screw has a point which is itself an independent screw that was put in to investigate the errors of the main screw, but it was found that the error of this screw was not as much as the ·00001 of an inch. The head is divided into two hundred parts, and by estimation can be read to 1·100,000 of an inch. Its constants are known, and it may be understood that it would not do to handle it very roughly. I could dwell here longer on this fascinating subject, but must haste. I may add that, if this spherometer is placed on a plate of glass and exact contact obtained, and then removed and the hand held over the plate without touching it, the difference in the temperature of the glass and that of the hand would be sufficient to distort the surface enough to be readily recognised by the spherometer when replaced. Any one desiring to investigate this subject further will find it fully discussed in that splendid series of papers by Dr. Alfred Mayer, on the minute measurements of modern science, published in the *Scientific American* supplements, to

which I was indebted years ago for most valuable information, as well as to most encouraging words from Professor Thurston, who is so well and favourably known.

(To be continued.)

THE EXPOSITION AT NEW ORLEANS.

By R. A. Proctor.

THE Exposition at New Orleans is certainly disappointing. The exhibits in what is called the Government Building are indeed full of interest; for here the various States and Territories display their special products effectively. Perhaps what struck me most in this part of the Exposition was the eagerness with which some of the Western States and Territories invite immigration, rather, as I judge, immigration from other States than from abroad. This is a significant feature of American progress; and, unless I mistake, marks one of the evil effects of that protective system which many Americans regard as the palladium of the nation. In the other parts of the Exposition we find what may fairly be described as a third-class exhibition after the manner of the recent exhibitions in London. There is nothing very new, and to walk along several miles (suppose) of shop counters, is not very attractive. So the exhibition is not proving a financial success. It has naturally given occasion to much talk about American trade. Oddly enough, many complaints are raised about the small amount of trade which America commands with other countries. This nation, which has foolishly adopted a system of protection, meant to advance American trade at the expense of that of other nations, is now grumbling because their own trade has suffered more than that of European nations. Even with the West Indies and South America, Europe does four times as much business as the United States can command. "Europe takes the palm and the four fingers," said an American recently, "leaving us the poor thumb." But Europe has done nothing of the sort. It has been the shortsighted policy of American party leaders, supposed by the American people to be statesmen (Heaven save the mark!) which has put America back fifty years, at the very least, in regard to foreign commerce. Recognising now, vaguely enough, the necessity of a wiser and freer system, these blunder-headed politicians (keen enough, though, when their personal interests are in question) set about lowering the tariff, after a manner only less mischievous than that in which they started their protective system. Take, for instance, the tariff on foreign sugar. By lowering this, they are ruining the sugar business of Louisiana. For how can the Southern traders possibly stand competition with those of the West Indies, when they have the high prices due to protection in manufactures, &c., to contend against? That the high rates on sugar were injurious to Americans generally, and therefore ought to have been removed or lowered, is, of course, obvious; but it should have been equally obvious that they could not be lowered by themselves without most injurious effects on the particular trade they affect. These effects will be quoted against free trade presently; whereas they are in reality due entirely to the utter ignorance of American politicians regarding even the most elementary laws of political economy.—*Newcastle Weekly Chronicle.*

In the table in Mr. Gorham's paper, in the second column of p. 322, "hundredths of an inch" should be *thousandths* of an inch.

THE KALEVALA.

By Edward Clodd.

VI.

IN the thirty-first rune a pathetic incident, which has only indirect connection with the main story as accounting for the death of the Northland maiden whom Ilmarinen wedded, and for his subsequent career, is interpolated.

Probably it is a relic of some older version of which the Kalevala and the 'Kalevipöeg are variants, for among the Esthonians Kullervo is their ancient king and glorious hero, who is to come again, like the sleeping heroes of other myths and races, and bring them everlasting happiness; whereas in the Kalevala he is a despised serf, drudging under the tyranny of a hard-hearted mistress. From beginning to end the Kalevala bears traces of the foreign and later influences to which it has been subject, resulting in the displacement of older gods and heroes in favour of newer and stronger ones, whose achievements, as in the case of the metal-workers, eclipsed their own.

When Kalervo, son of Kaleva, was slain by his brother Untamo, Kullervo sought to avenge his father's death, and Untamo at last got rid of him by selling him to Ilmarinen, whose wife made him her hind. In revenge for her harsh treatment he, by enchantment, changed her cows into bears and wolves, which he drove to the farm, so that when she went to milk them she was torn to pieces. He then escaped and made his way to the home of his childhood, where he found his mother in grief at the non-return of his sister, who had gone many days before to gather berries in the forest, and who had not been seen since. So he set forth in search of her, and on his way met a girl fair to look upon, with whom he fell in love, and who yielded to his embrace. As they travelled together, she asked him concerning his kindred. "What is thy race, bold young man, and who is thy father?" Kullervo answered, "I am the wretched son of Kalervo; but tell me what is thy race and who is thy father?" Then said the maiden sadly, "I am the wretched daughter of Kalervo. Ah! would God that I had died, then might I have grown with the green grass, and blossomed with the flowers, and never known this sorrow." With this she leaped into the midst of the foaming waves and found peace in the river of Tuoni, the Lethe of the Kalevala.

Kullervo hastened home to confess to his mother to what shame and sad end he had unwittingly brought his sister, and would have destroyed himself; but his mother entreated him not, whereupon he set out to avenge the common wrong they had suffered at the hands of Untamo. This done, he returned home, and, on finding the place abandoned, he went shooting in the forest, and coming to the spot where he had violated his sister, he, stricken with remorse, killed himself.

Sorrow sat heavily on the bereaved Ilmarinen, and he sought relief in his craft. With the help of hired workmen and thralls he smelted the precious metals, but both hirelings and slaves slackened in their labour; so he took the bellows himself, and fashioned many things, until there arose from the fire a yellow-haired maiden of gold and silver, with neither mouth nor eyes. These Ilmarinen gave her; but although, like Galatea, she was endowed with life, she could not speak, nor could he bestow that gift upon her. Whichever side he turned towards her he was frozen, so that he quickly wearied of her, and offered her to the "old and steadfast" Wäinämöinen. But the venerable wooer looked askance on such a gift from such

a quarter, and refused it, at the same time warning younger men never to marry a wife of gold and silver.

In the thirty-eighth rune Ilmarinen betakes himself to Pohjola to woo by sweet persuasion, or seize by ruthless force, his deceased wife's sister. Whether or not a union of that kind was within the "prohibited degrees" in Pohjola we are not told; but the maiden refused his suit, and was carried off by force. Ilmarinen, however, soon repented of his rashness, and, incensed by her taunts and ceaseless naggings, uttered some magic words whereby she was changed into a seagull.

This is the last of the business of love-making and bride-lifting that we have in the Kalevala. The brothers cease their rivalry for women's hearts, and unite in a different quest. When Ilmarinen returned, Wäinämöinen asked the cause of his sadness, why his head hung down, and why he wore his cap on one side in token of grief? Ilmarinen told him all that had happened, and then described the prosperity and plenty which the wonder-working Sampo had brought to Pohjola. This made Wäinamöinen covet it, and he proposed to his brother that they should try to get it. Ilmarinen dwelt on the difficulty of this, for the Sampo was kept in a copper mountain, and secured by nine bolts and nine locks; moreover, its roots stretched nine fathoms deep, one in the earth, one in the water, and one on the brink of the sky. However, in the end he agreed to go, and after forging swords and armour for both, sought for horses. These were not forthcoming, and whilst they were debating what to do, Wäinämöinen heard a boat sighing and bewailing to itself, "The house of the man is the longing of the maiden; the billows of the sea are the longing of the boat." So the heroes unloosed it, singing it into the billows, but a crew was lacking to set the sails and man the oars. Wäinämöinen gathered these, curly-haired youths; hard-handed, booted men; by the power of song, and took the helm himself:

> Joy is heard upon the ocean,
> Joyous singing on the waters,
> Beauteous song like this ne'er sounded,
> Such sweet singing ne'er was dream'd of.
> Aged Wäinämöinen's own hand
> Steers his ship between the breakers,
> Steers between the lofty mountains,
> Onward through the sounding billows,
> Between cliffs in seething waters.
> Never struck the hero's vessel,
> Tarried not, nor stayed its sailing.

As they voyaged, they saw Lemminkäinen, *alias* Ahti, god of the sea, sitting on a headland, and he gladly joined them, having an old score to pay against the Northlanders. They came to a waterfall, and Wäinämöinen prayed to the Naiad who dwelt by it for leave to force the boat through the rock over which the water broke; but, although he prayed to Ukko also, the boat grounded, not on the rock, but on the shoulders of a big pike, which Wäinämöinen killed and hauled on board. Then with its bones the old singer made a wondrous harp, the strings for which were hairs taken from the tail of the horse of Hiisi, and on which he invited Ilmarinen and Lemminkäinen, the young and old, yea, even the hostess of Pohjola herself, to play, but none of them could bring forth sweet sounds as their fingers swept the strings. Then the immortal singer took the harp and played so divinely that Tapio, the forest-god, came forth with his wife, Miellikki, in her blue stockings and shoes tied with red ribbons; Ahti, god of the waters, rose between the leaves of water-lilies to listen; the wolf awoke in its cave, the bear danced on the heath, the eagle flew down from the sky, the hawk from the cloud, the duck rose from the sea, the swan from the river, the fishes with their six fins, the salmon and the pike, not a bird of the air, not a beast of the forest, not a fish of the waters, but came and listened to the lovely strains evoked by the "old and steadfast." The daughters of the sun and moon, Kuntar and Päivätär, seated on the rainbow and on rosy clouds, stopped weaving their golden web; the water-nymphs forgot to comb their loose locks; no heroes were so inflexible but that they were moved and wept; men and maidens, the married and the unmarried, the aged and the little children, all wept for very joy, and the harper himself shed tears "big as berries and numberless as the feathers of a swallow." The great drops rolled down his breast and knees, they wetted his "five woollen jackets, his six golden belts, his seven blue shirts, his eight flannel waistcoats," and, falling into the sea, were changed into pearls. A blue duck

> Hastens then to seek the tears that
> Wept by aged Wäinämöinen
> Sank beneath the water's clearness,
> Down into the depths of ocean;
> Gathers all the tears together;
> Lays them in the hand of Waino;
> But they all have been transformèd,
> Been all gloriously changèd;
> Changèd into pearls are tear-drops,
> Shining pearls of wondrous clearness,
> Destined for the joy of heroes
> And to deck the crowns of rulers.

Arrived in the Northland, Wäinämöinen told Louhi his business, and demanded that the Sampo be divided between them. "No," said Louhi, "you cannot part a minever, and the squirrel is too little for three." On this refusal, Wäinämöinen, who saw that her soldiers were marshalled for the fight, took his harp and lulled all the people of Pohjola to sleep. As he played, the bolts of the doors that shut-in the Sampo moved, and Ilmarinen greased them with butter and pushed back the locks, but could not reach the Sampo. Then he took an ox with a thousand heads and a hundred horns wherewith to plough up the ground till he could seize the Sampo, which done, he carried it to the boat. As they sailed away, Wäinämöinen sang so triumphant a strain that he awoke Louhi and her people from their three days' trance. Furious at the loss of the talisman, she sent a driving mist, and raised a hurricane so violent that it blew Wäinämöinen's harp into the sea. Then, with a boat manned by a thousand hands to pull the oars and a thousand to work the sails, she started in pursuit, but Wäinämöinen destroyed her boat by magic.

Undaunted by this she changed herself into an eagle with claws of scythes (reminding us of the Harpies of Greek myth, storm-goddesses with pointed claws), and bore upon her wings a hundred armed men, upon her tail a thousand, and ten upon each feather. Swooping down upon the heroes, she seized the Sampo with her claws, nor, although Ilmarinen and Lemminkäinen attacked her with swords, and although Wäinämöinen maimed her with the rudder, could they recover the treasure. At last, too wounded and exhausted to hold it longer, yet determined not to surrender it, she threw it into the sea, where it was dashed into fragments. Of these, the larger number fell to the bottom and brought treasures to enrich the palace of Ahti, the ocean-god, the rest were drifted to the shores of Kalevala, also bringing good-luck with them, while Louhi secured only the cover. There is a good deal of confusion in the epic about this cover, some descriptions of the Sampo representing it as the many-coloured, ornamented lid or cover, as if it were a disc, or a shield; in one account of it, gathered from the Finns in Verenland, it is spoken of as a flying thing, but, as shown in the remarks in a previous paper on its likeness to the famous quern, the several foreign

elements in it make their separation from the primitive native elements a difficult task.

As Wäinämöinen could not recover his harp, he made another. Its framework was cut from a birch-tree, which, like the boat he sailed in to Pohjola, was heard lamenting its purposeless life, and its strings were woven of the hair of a lovelorn girl. Like the lost harp, it brought gladness to all the land when the old minstrel swept the strings with his master-fingers, and it charmed away the ills which the revengeful Louhi sought to inflict on Kalevala. She sent plague and disease, but Wäinämöinen healed the smitten; and when she sent a bear he killed the monster, "and the body was brought home with the bear-dance and the hymn of the bear. 'Oh, Otso,' cry the singers, 'be not angry that we come near thee. The bear, the honey-footed bear, was born in lands between sun and moon, and he died not by men's hands, but of his own will.'" "The Finnish savants," remarks Mr. Lang, "are probably right who find here a trace of the beast-worship which in many lands has placed the bear among the number of the stars." While Wäinämöinen was playing at the banquet over the slain bear, the sun and moon came down to listen to him, and Louhi succeeded in capturing them and shutting them up in a copper mountain, as she did the Sampo. She also at the same time stole the hearth-fire from the heroes, thus depriving them of both light and warmth. Ukko, the Supreme, who, when he appears in the epic, is more often depicted as leaving mortals to act on the maxim that they are most helped by Heaven who help themselves, struck fire to kindle a new sun and moon. The fire, which acts throughout as a living creature, has all kinds of adventures. It fell to the earth, and both Wäinämöinen and Ilmarinen searched for it in vain, till Luonnotar told them that a guinard had swallowed it. The guinard was swallowed by a salmon, and the salmon was swallowed by a pike, which the heroes at last, after two attempts, caught with a hempen net. Having no iron gloves with which to lay hold of it, the fire eluded them, and, burning Ilmarinen as it escaped from the salmon, carried "red ruin" through the land. Variants of the story alike speak of the salmon as the fire-fish, and the Finnish runic incantations against fire banish it to the salmon's tail, by which it is inferred that Ilmarinen was burnt in trying to capture the fire. In the prose Edda, when Loki had caused the death of Baldr, he flees from the wrath of the gods and changes himself into a salmon. He slips through the meshes of a net which the gods cast for him, but in the second cast he tries to leap over it, and is caught by Thor. "Being, however, extremely slippery, he would have escaped had not Thor held him fast by the tail; and this is the reason why salmons have had their tails ever since so fine and thin."* Loki, as the name indicates (Swedish, *logi*, flame), is the evil fire-god, and the similarity in outline between the two stories is probably referable to the influence of Scandinavian myth on that of the Finns.

Ilmarinen then forged a new sun and moon, but could not make them shine, and Wäinämöinen, having found out where the true sun and moon were hidden, went to Pohjola, but was not able to recover them for lack of tools to open the magic mountain.

While Ilmarinen was forging these, Louhi, anxious to know what he was doing, flew to him in the form of a swallow, and asked him.

He replied:—

> "It's a necklace I'm forging
> For the mistress of Pohjola,
> Wherewithal to chain her firmly
> To the ledges of the mountain,

* Mallet's *Northern Antiq.*, p. 450.

which so frightened her that she released the sun and moon, and at their shining in the heaven, Wäinämöinen sang a song of joy, the last wherewith he was to gladden his people. How this came about needs a concluding chapter to tell.

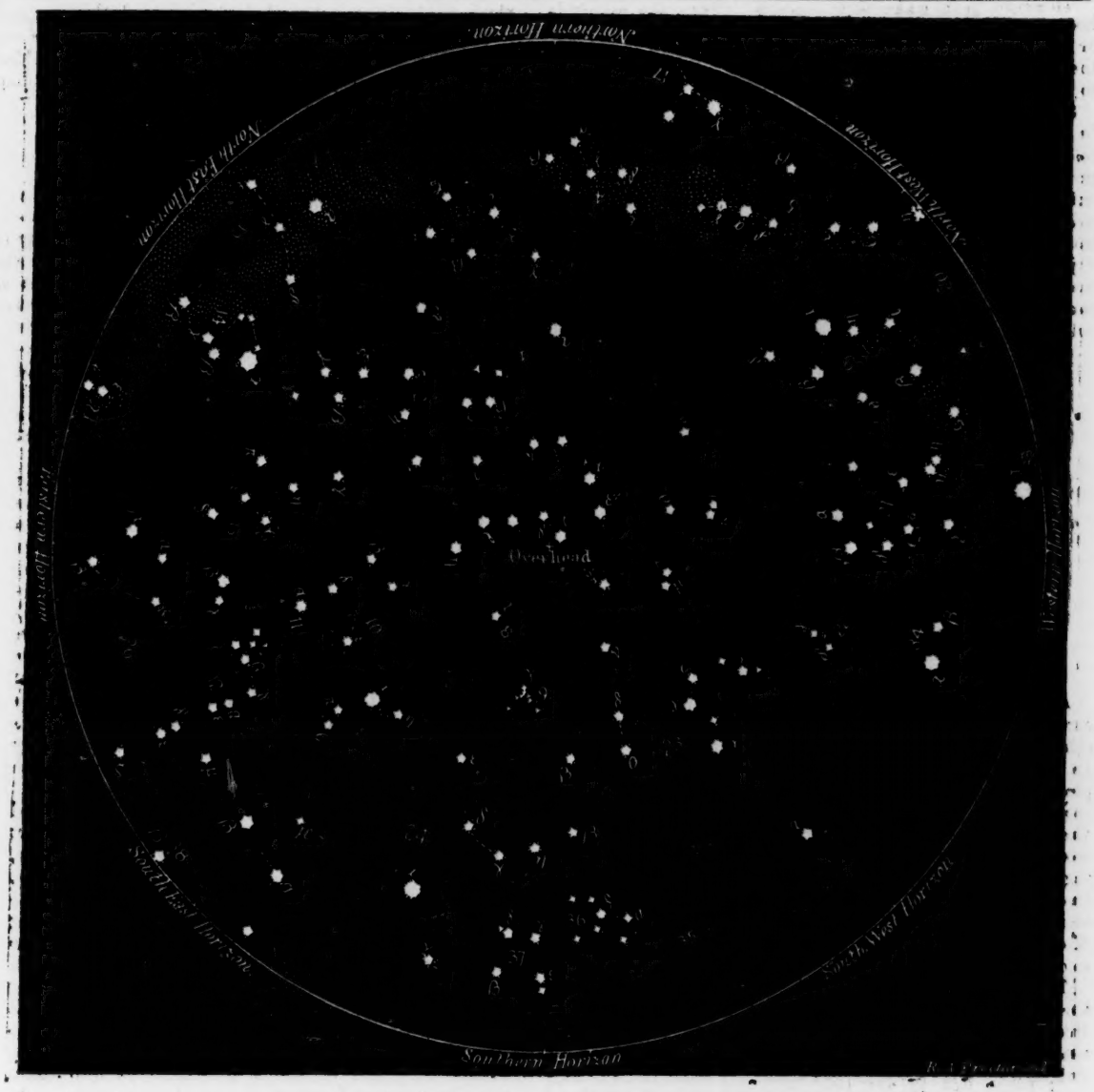
FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albireo*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*)
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

Under the title of "The Imperial Parliament" a series of short volumes on current political topics is about to be issued, under the editorship of Mr. Sydney Buxton, M.P. The volumes will be written by politicians who are recognised as authorities on the subjects of which they treat. Each volume will be complete in itself, uniform in crown 8vo. neatly bound in a permanent form, and issued at the price of one shilling. Messrs. Swan Sonnenschein & Co., of London, are to be the publishers. Nine volumes are already arranged for. The subject of the first volume of the series, which will be published immediately, is "Imperial Federation," and is treated by the Marquis of Lorne. Sir John Lubbock, Bart., M.P., will follow with a volume on "Representation"; and Messrs. Wm. Rathbone, M.P., A. Pell, M.P., and F. C. Montague will together write on "Local and County Government." These three volumes will be produced shortly. In the course of the summer and autumn Mr. W. S. Caine, M.P., and Mr. Wm. Hoyle will together contribute a volume on "Local Option"; Mrs. Ashton Dilke and Mr. Wm. Woodall, M.P., will write on "Women's Suffrage"; and Mr. Henry Richard, M.P., and Mr. Carvell Williams on "Disestablishment." Mr. H. Broadhurst, M.P., and Mr. R. T. Reid, M.P., combine on "Leasehold Enfranchisement," while Mr. Baxter, M.P. will produce a volume on "Taxation and Tariffs," and Mr. Bryce, M.P., one on the "Reform of the House of Lords." Other volumes will follow. We invite attention to this series rather in its sociological aspect, since, though political, it will, it is stated, not be of a party character.



NIGHT SKY FOR APRIL (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

April 14 at 10½ o'clock.	April 21 at 10 o'clock.	April 29 at 9½ o'clock.
April 18 at 10¼ o'clock.	April 25 at 9¼ o'clock.	May 1 at 9¼ o'clock.

TRICYCLES IN 1885.

By John Browning.

(Chairman of the London Tricycle Club.)

HOW TO SHELTER A TRICYCLE.

THE best method of sheltering a tricycle is a matter of consequence to everyone who possesses a machine. Most persons, who have no stable or outhouse, put their tricycle up at the nearest livery-stables. This is expensive and inconvenient, and the machine is liable to injury from carelessness or ignorance on the part of the stablemen or visitors to the stables. I have also known machines to suffer much damage in such places from the effects of damp, either rising from the ground or thrown about in washing the floor of the stable, or the vehicles kept in it.

When the owner of a machine lives in a terrace house in a town or the suburbs, he frequently gets a narrow-gauge machine like the Coventry Rotary or a collapsible machine of some kind, the forms of which are too numerous to mention, but the first-named machine has the disadvantage of being a single-driver, and collapsible machines, like all make-shift contrivances, seldom work well and give satisfaction to their possessors long together, though a few very careful riders get on pretty well with them. There are, however, many tricyclists living in detached

houses with good garden ground who use narrow-gauge or collapsible machines so that they may be able to take them into the house, from being unaware how easy it is to have a *portable* house in their garden.

Some very useful houses made of corrugated iron are to be purchased, and these answer the purpose of protection tolerably well; but they would be better if they were provided with apertures, which, without admitting wet, will admit of ventilation. Metal, also, is not the best material of which such houses can be made, because it takes up changes of temperature too rapidly. Many persons object to the appearance of the galvanised iron, the bright metal in the garden looking too conspicuous. This objection can be got over by covering them with a coat of paint or coloured varnish.

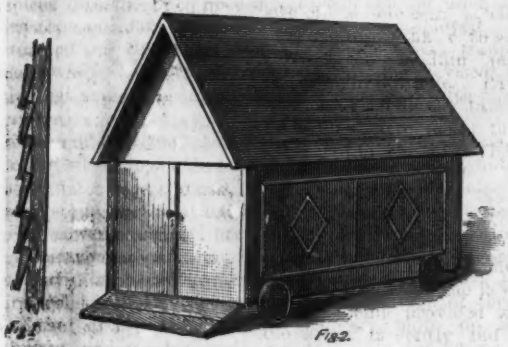


Fig 1. Fig 2.

A light wooden house which can be cheaply made by any carpenter, of feather-edged boards, laid on overlapping each other, with apertures permitting of ventilation, is far better. In this ventilation can be provided to any extent, by placing strips of wood about 3 in. wide and a quarter of an inch thick, between the ends of the feather-boards where they are nailed on to the quarterings, which form the framework of the house. Or the framework formed of quarterings may be covered with strong canvas, which should have two or three coats of paint. This would be cheaper and lighter than wood, and answer every purpose as well. A coat of paint over the canvas occasionally will make it so durable that it will last for years.

The floor of every tricycle-house should be raised above the ground at least six inches, and a small slope placed in front, which may be hung on hinges, to run the machine readily into it. A good way of raising the floor is by putting four wheels, about 6 in. diameter, under the corners of the house, for otherwise it is often found, after such a house has been built, that its position can be changed with advantage.

Where it is a matter of consideration that the tricycle shelter shall be as sightly and as little conspicuous as possible, I would advise that where the surrounding objects, such as foliage ground or evergreens, are dark, the shelter should be painted of a dark colour to harmonise with them. In the case of its being surrounded with dark evergreens, it should be painted olive-green, with a few lines on the sides of a lighter colour for the purpose of ornamentation. Where it is among light objects, or in an open space, it should be painted a sage-green, with the ornamental lines in a rather darker shade of the same colour.

There can be no doubt that, with an estimated number of nearly half a million cycle riders amongst us, it will be worth the while of builders before long to erect houses with doorways wide enough for tricycles to pass through them, or, better still, to provide a small outhouse to securely shelter them.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XXIV.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

HENMAN'S "Safety Sanitary Trap," noticed in the concluding remarks of our last issue, rightly presupposes an unwholesome condition of things in the majority of domestic drains and soil-pipes, and seeks to overcome those grave defects by means of an easily-fixed and economical appliance, placed in such a position that it cannot very well get out of order. With such a protection, the simplest form of untrapped closet-basin can be used, provided that adequate means for flushing are employed. Of these, and of the many varieties of excellent trapped closets which have from time to time been devised, we shall treat when we come to deal more specially with closet furniture.

Although excrementitious waste-products are extremely offensive when fresh, they are, as a rule, innocuous, unless tainted with disease-germs. It is not until about after a lapse of four days in this climate that decomposition sets in, and sewer-gases are produced. These consist principally of carbonic acid, light carburetted-hydrogen or marsh-gas, heavy or bi-carburetted hydrogen (olefiant gas), sulphuretted hydrogen, and ammoniacal gas. All of these, with the exception of marsh-gas, are, more or less poisonous, and especially dangerous within the rooms of the house. One of the principal means by which they are liable to enter the abode is through a defective, and oftentimes by way of an unused closet; the gases are chiefly drawn into the house in virtue of its relatively higher temperature, when occupied and warmed with fires, &c.

We have often remarked that a thoroughly sound system of ventilation applied to the house-drains would get rid of the danger from sewer-gases, and we are, therefore, glad to be able here to draw attention to a new invention, not only for the removal of sewer-gases by the establishment of an upward, continuous, and powerful current along the soil-pipe, but, in addition, for the destruction of those harmful products, associated, as they generally are, with countless deadly germs. In an address on the reopening of the "Parkes Museum of Hygiene," Professor Tyndall said:—"The physician and the sanitarian have no longer to fight against phantoms, requiring only the fortuitous concourse of atoms to bring them into existence. Their enemy is revealed, and their business is to thwart him, to intercept him, and to *slay* him. It is not noxious gases but organised germs which, sown in the body, and multiplying there indefinitely at the body's expense, produce the most terrible diseases by which humanity has been scourged. Contagia are living things. Men and women have died by the million that bacteria and bacilli might live. Reason repudiates this sacrifice of the greater to the less, and will invert it if possible. . . . . These virulent organisms, these ferments of disease, hang about the walls, the furniture, and the clothing of the sick-room. How is the room to be disinfected? They are diffused in the air of our drains. How is that air, which is sufficiently noxious on its own account, to be prevented from entering our houses? We know how typhoid fever is generally spread. How are our water and milk to be protected from that contagion? Our hospitals, it is said, infect their neighbourhoods. Is not this preventible? Through the downcast shaft of a coal-mine the fresh air enters, sweeps the noxious gases of the mine along with it,

and escapes through the upcast shaft into the open air. Can we not imitate this arrangement in our hospitals? Drawing for our intake upon the pure atmosphere, carrying it through the wards, *and making it pass through a ventilating fire* before finally ejecting it, no contamination of the surrounding neighbourhood would be possible?

In the practical endorsement of the words we have italicised above is to be found one of the most important of modern improvements in the construction of drains, so as to cope adequately with sewer-gas and bacteria. Messrs. William Hill & Sons, of Manchester, have recently introduced a patent "Extractor" ventilator of great merit, which we shall have occasion to describe carefully when we come to the subject of house ventilation; it deserves special mention here, because it can be applied most advantageously to soil-pipes, for the removal and destruction of poisonous gases. It consists of a jet of gas, regulated by a governor, and fixed in any convenient position; the apparatus has been so designed as to economise, and with a minimum supply of gas to produce a constant upward current of strongly-heated air, under any condition of weather. The flame, moreover, is protected from down-blows, and, as it is well enclosed, is perfectly safe. It thus follows that, not only are all germs destroyed, but the consumed gases are rapidly driven away into the general atmosphere, where they cannot possibly do any injury. It has been estimated that a small extractor for ordinary rooms will, with a gas consumption of 2 or 3 ft. per hour, create a velocity of from 200 to 400 ft. per minute, in tubes or shafts varying from 6 in. in diameter to 15 in. in diameter, and will continuously extract from 3,000 to 17,000 cubic feet per hour, independently of the aid of wind or air-pump cowls, which increase the velocity while the wind prevails.

Another very valuable innovatiom in sewer-reform is Messrs. H. T. Johnson & Co.'s "Patent Hygienic Furnace," also being introduced by Messrs. Hill & Sons, of Manchester. These furnaces are specially recommended for constant use in very crowded districts, where sewer-gases and disease-germs rise continuously from the manholes and other ventilators into the streets, or are wafted downwards in dangerous proportions from relieving-shafts. In tolerably healthy, uncrowded parts they need not be perpetually in action. In all places they create a circulation of gas in the sewers, and draw it through an intense heat—600° to 700° Fahr.—thereby acting as "ventilating fires," relieving pressure from the sewer side of the house-drain, and completely destroying all disease-germs. The moderate price of the appliance which embodies so many qualities of the most vital importance to the healthy condition and easy management of our public sewers must, we rest assured, bring it into deservedly universal employment ere long.

Mr. Thomas Kay, of Stockport, lately read a paper before the Manchester Literary and Philosophical Society in which he suggested a method of making sea-water potable by precipitation. He suggests that every ship's boat should be supplied with a quantity of citrate of silver, which should be used for precipitating the chlorides, leaving the sodium, potassium, magnesium, and other constituents in solution as citrates. The solution would be similar to ordinary effervescing draughts after the gas has escaped: it would be slightly aperient or slightly diuretic if taken in too large quantities, but still suitable for moistening the parched mouth. The expense of the silver would be but a small addition to the capital sunk in a ship, and the interest on it would be a small insurance premium against thirst in case of disaster. The value of the silver would not decrease, and could always be realised if disaster did not occur. The scheme seems practicable if the solution of citrates is sufficiently weak to be potable; only experience can prove this. The silver, being very portable, not easily identified, and easily reduced to metallic silver, would offer great temptations to petty larceny.—*Engineer.*

Editorial Gossip.

In the first volume of the "Journal of the Meteorological Society" will be found a paper by Mr. Glaisher "On the direction of the wind at the Royal Observatory, Greenwich, for the ten years ending December, 1870." From an average of these ten years, as there given, I gather that during the first four months the wind blew from the N.E., E., or S.E. 783·5 hours; while during the same months it was in either the N.W., W., or S.W. no less than 1,416·1 hours; almost exactly double the time. If meteorologists in London, and, in fact, in the south-east of England generally, will consult their registers for January, February, March, and April of the current year, they cannot fail to note how strangely this proportion has changed. Can the office in Victoria-street furnish us with any feasible hypothesis of the very greatly increased percentage of easterly wind in England which has lately been so striking?

I have heard it said that the British tradesman can and will adulterate anything whatever except an egg, and I am really not sure that, with the march of applied science, even the sophistication of that will long remain unaccomplished. The latest device of which I have heard or read takes the form of a compound to deceive that ordinarily astute class of people the pawnbrokers, and is not inappropriately termed "mystery." It would seem to be composed of copper, platinum, and tin, got up to represent nine carat gold, and as it stands the test of nitric acid perfectly, it appears really admirably calculated to deceive a much wider public than that which it has seemingly been first used to experiment upon, and to afford even a more effectual trap for our sisters and our cousins and our aunts than for our "uncles" themselves. When henceforth I see a barmaid with a massive necklet and locket, or 'Arry with a gold "albert" chain that would hold a mastiff, the thought will inevitably cross my mind: This is a great mystery!

Since the above paragraph was in print, I note an authoritative statement that a very considerable number of sovereigns made of this compound are in circulation, and that in ring, weight, and general appearance they are wholly undistinguishable from the genuine coin. Two of these spurious sovereigns tested by an analyst had the date 1873 upon them. If the Government can devote any time to such a comparatively trivial matter as the sterling character of the currency, this would seem to require very immediate action indeed.

Apropos of fraudulent substitution, here is a pretty paragraph which has gone the round of all the papers:—

> The new pattern swords lately issued to the cavalry regiments at Aldershot have been tested within the last few days, with the result that the larger portion of them have been found defective and returned to the makers.

So, for the sake of a few pounds to be gained out of their contracts, these highly-respectable sword-cutlers have sent in weapons which must infallibly have failed in the hands of the gallant fellows who would have been trusting their lives to them. This is akin to the behaviour of a chemist who makes up a prescription (on which the life or death of the patient may hang) with adulterated drugs. It is devoutly to be hoped that the Attorney-General will find some means of making such high-principled and conscientious people suffer most severely for their conduct. The utter ruin of a few of the gentry who supply the

XUM

Government with "bogus" sword-blades would not, necessarily, entail national mourning.

To anyone who may wish to see the question of legislation for the suppression of intemperance calmly, logically, and lucidly discussed, I would commend the perusal of a little penny tract entitled "Drink," written by Lord Bramwell.

THE FACE OF THE SKY.

From April 24 to May 8.

By F.R.A.S.

THE sun, now getting pretty high up in the sky, should be examined for spots and faculæ whenever he is visible. Maps IV. and V. of "The Stars in their Seasons" show the aspect of the night sky. Mercury comes into inferior conjunction with the sun at 3 a.m. on the 28th, and is, for all practical purposes, invisible during the next fourteen days—a remark equally applicable to Venus, who arrives at her superior conjunction with the sun at 5 p.m. on May 4th. Mars is invisible, too. Jupiter must be looked at as soon as ever it is dark enough, to be seen to any advantage, as he is rapidly approaching the west; he is still the brightest object in the night sky. He is travelling towards Regulus. The phenomena of his satellites continue to present a series of interesting spectacles to the observer. To-night (24th) the transit of Satellite II. begins at 8h. 34m., and that of its shadow at 10h. 57m. Satellite II. itself leaves Jupiter's opposite limb at 11h. 30m., the shadow not until to-morrow morning. On the 25th Satellite III. may perhaps be seen in the twilight to leave the planet's face at 7h. 55m. p.m. Its shadow will not even enter on to Jupiter's disc until an hour and eleven minutes afterwards, or at 9h. 6m. It will pass off forty-one minutes after midnight. On the 26th Satellite II. will reappear from eclipse at 8h. 59m. 32s. p.m., as will Satellite IV. the next evening (the 27th) at 8h. 35m. 43s. Later, Satellite I. will be occulted eleven minutes after midnight. On the 28th the transit of Satellite I. begins at 9h. 31m., and that of its shadow at 10h. 44m. At 11h. 51m. the satellite leaves Jupiter's opposite limb, as does its shadow next morning. On the 29th, Satellite I. reappears from eclipse at 10h. 8m. 58s. p.m.; and on the 30th perhaps the egress of the shadow of this satellite may be perceived at 7h. 32m. in the evening. On May 1st, Satellite II. begins its transit at 11h. 5m. at night. On the 2nd, Satellite III. enters on to Jupiter's disc at 8h. 3m., and quits it at 11h. 43m. The student should carefully watch this transit for the reason so repeatedly given here. On the 3rd, Satellite II. reappears from eclipse at 11h. 35m. 17s. On the 5th, the transit of Satellite I. begins at 11h. 24m.; and that of the shadow of Satellite IV. at 11h. 37m. Satellite I. leaves the planet's face thirty-nine minutes after midnight. On the 6th, Satellite I. will be occulted at 8h. 32m. p.m., to reappear from eclipse at 12h. 4m. Lastly, on the 7th, the egress of Satellite I. from the disc of Jupiter occurs in twilight at 8h. 12m., and that of its shadow at 9h. 27m. Saturn may be caught over the western horizon after dark, but is now leaving us for the season. Uranus, still situated to the west of η Virginis, should be looked for as soon as convenient after dark. He is still perceptible to the naked eye of the observer who knows where to look for him. Neptune is wholly invisible. The Moon is full at 6h. 14·3m. a.m. on the 29th, and enters her last quarter at 8h. 43m. in the morning of May 7. Two stars only will be occulted at convenient hours during the next fortnight. To-night (24th) d Leonis, a star of the 5th magnitude, will disappear at the Moon's dark limb at 11h. 7m. at an angle of 135° from her vertex, to reappear at her bright limb at 11h. 58m. at a vertical angle of 238°. On the 26th, B.A.C. 4255 a 6¼th magnitude star will disappear at the dark limb at 8h. 28m. p.m. at an angle from the vertex of the Moon of 66°. It will reappear at her bright limb at 9h. 39m. at an angle of 219° from her vertex. At noon to-day the Moon is in Sextans, but emerges into Leo at 5 p.m. She quits Leo for Virgo at 6 p.m. on the 25th, across which she is travelling until 11 p.m. on the 28th, when she enters Libra. In her passage across Libra she arrives at 11 p.m. on the 30th at the western boundary of the narrow northern strip of Scorpio; but this she crosses in 10 hours, and emerges in Ophiuchus at 9 o'clock in the morning of May 1. She completes her journey through this by 7 a.m. on May 3, when she enters Sagittarius. She leaves Sagittarius for Capricornus at 10 p.m. on the 5th of May. At 5 p.m. on the 6th she crosses into Aquarius, and is still in that constellation when these notes terminate.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

THE DEATH-WATCH.

[1679]—I see, in the account of the death-watch, in the last number of Knowledge, some doubt appears to be expressed as to the possibility of a ticking sound being produced by the little light-coloured paper-louse therein mentioned.

I captured a number of these insects upon several occasions, and kept them in a little paper box I constructed, and there can be no manner of doubt that they *did* tick, and tick very loudly, too. I captured the last set which I thus kept upon an old piano, on which they swarmed, and which they seemed to consider quite a happy hunting-ground. At all events, I made it a happy hunting-ground for myself.

I could not make out what they fed upon in the paper box—maybe on the paper itself; but if so, they did not succeed in eating their way out, though I kept them for several weeks. They used to keep up long conversations with me, answering readily, whenever the room was still, when I tapped lightly, in imitation of their own sound, on or near their box. They used frequently to tick when at liberty in the old piano-case, too, in answer to my calls. Their ticking was more hurried, I think, than the deliberate "tick, tick, tick" of the beetle death-watch. I never succeeded in extracting from them, however, whether they really considered it quite in accordance with strict honesty to go all their lives upon tick in this fashion.

But, at any rate, I, at all events, have no manner of doubt whatever that those little whitish, soft-bodied lice are perfectly capable of making a ticking noise of a quite astounding loudness—that they do, in fact, make it very frequently, and make it as an answer or call of some sort. William Fitzgerald, Clk.

[I can corroborate Mr. Fitzgerald's assertion as to the ticking of the Atropos pulsatorius from my own personal experience, having caught the insect on two occasions in what I may term *articulo ictûs*. How so soft-bodied and fragile a creature contrives to simulate the metallic ring of a watch so accurately, though, is nothing short of marvellous.—Ed.]

EVILS OF THE AGE: BAD LANGUAGE.

[1680]—Would it not be a good idea if some steps were taken to improve the style of conversation at present in vogue amongst the lower classes?

As a rule, their English is bad, and there is a marked absence of the letter H; but although this jars upon the ear, and should be corrected when possible, what we more particularly refer to are the objectionable expressions that we meet with at almost every step.

Ladies occasionally walk across the fields and stop to look at a juvenile game of cricket, or join in a crowd witnessing sports, races, &c., but there is every chance of their being compelled to listen to some very choice language, generally representing all surroundings as of a sanguinary composition, with other expressions of a still less agreeable nature.

It is impossible that the guardians of our youth can be ignorant of these facts, as they are patent in our very streets.

We have Blue Ribbon Armies, and Salvation Armies, why not organise a society for the suppression of bad language?

There are too many philanthropists ever ready to take up a good

cause, to make it necessary for us to do more than call attention to this point, and we hope that after due ventilation of the subject some will come forward, take the matter in hand, and propose a remedy.

Simply from hearing bad language, young people pick it up and use it glibly. It sometimes makes one shudder to hear the words that proceed from the mouth of a youngster of decent appearance and tender age, without the slightest suspicion on his part that he is wounding the susceptibilities of his auditory, or doing anything that is not quite manly and pleasant. N.

April 13, 1885.

ARE TRIPE AND ONIONS OBJECTIVE OR SUBJECTIVE?

[1681]—"J. S." (1664) enjoyed his "Friday night's supper of tripe and onions," and is indignant that any doubt should be cast upon its "external existence." But can "J. S." certify anything respecting this substantial repast excepting the existence of a group of odours, tastes, and visual and tactual sensations, collectively entitled "tripe and onions"? Did not these sensations exist *within* his own mind, and is not the group the "thing felt and thought"? However, if "J. S." will read my former letters attentively he will find that I do not question the production of sensations, &c., by the interaction of consciousness with something existing independently of consciousness. To do so would involve, among other consequences, rejection of the results of geology and astronomy, which would be even worse than the abolition of "tripe and onions." I merely assert the truism that matter can be known only by sensation and thought; or, in other words, that sensations and thoughts are all we know of matter.

The editor lately recommended certain correspondents to study Lewes's account of Berkeley. Perhaps, with reference to the editorial note attached to the letter of "J. S.," I may quote part of a passage from Berkeley's "Principles of Human Knowledge," with a comment by Lewes, first premising that I am by no means a Berkeleyan.

"If the word *substance* be taken in the vulgar sense for a combination of sensible qualities, such as extension, solidity, weight, &c., this we cannot be accused of taking away. But if it be taken in the philosophic sense, for the support of accidents or qualities without the mind, then, indeed, I acknowledge that we take it away. . . . . Assert the evidence of sense as high as you please, we are willing to do the same. That what I see, hear, and feel, doth exist—*i.e.*, is perceived by me—I no more doubt than I do of my own being; but I do not see how the testimony of sense can be alleged as a proof of anything which is not perceived by sense."

Lewes inquires, "Where was philosophical acumen when a tribe of writers could imagine they refuted Berkeley by an appeal to common sense—when they contrasted the instinctive beliefs of mankind with the speculative paradoxes of a philosopher, *who expressly took his stand with common sense against philosophers?*"

C. N.

[Montrond said that "Language was given to man to conceal his thoughts;" and certainly, accepting "C. N.'s" rendering of Berkeley's theory, the Bishop of Cloyne affords an admirable illustration of the truth of this aphorism. "It is," he says, "indeed an opinion strangely prevailing amongst men that houses, mountains, rivers, and, in a word, all sensible objects, have an existence, natural or real, distinct from their being perceived by the understanding!" At this rate the very perceptive brain itself is resolved into the sum of a man's sensations, and we are left with nothing but Mind (whatever that may be) in the Universe. All this appears to me the veriest logomachy.—Ed.]

VIVISECTION.

[1682]—I have read with great interest the letters that have appeared in Knowledge with regard to the horrible practice of vivisection. I cannot help thinking, however, that the anti-vivisectionists are wanting in ardour, wanting in courage, and wanting in knowledge, at least—not fully alive to the terrible realities that are being enacted around us every day. Are they aware that the University of London—a body altogether unlicensed for this purpose—in defiance of the law, countenances—and, in fact, enjoins—unlicensed vivisection within their walls? There is not even the wretched plea of research; these are merely demonstration experiments. Not only so, but not the slightest provision is made for anæsthetics, and the experiments are entrusted to the unskilled as well as unlicensed hands of the junior students. Surely such open infringement of the law must, by some strange blindness, have escaped the notice of the anti-vivisectionists, or they would have been down on the University "like a thousand of bricks."

With an ingenuity which it would tax even an anti-vivisectionist to excel, the University does not incur the penalty herself—and, indeed, she enforces it on no one, leaving open only the alternatives of becoming a mark for the anti-vivisectionists or of failing in the examination. With a refinement of cruelty beyond what was to be expected even from the most enlightened of scientific investigators, she requires the operation to be performed by the experimentor on himself. "Make a microscopic preparation of human blood!" are the cold-blooded directions of last year's Intermed. B. Sc. paper on practical biology.

For my part, I must confess to performing the indicated operation much against my inclination, and with pain. Lest, however, I should render myself liable to prosecution from the Anti's, I must beg you not to disclose my name, but to subscribe me

A Victim of Vivisection.

[As this "Victim of Vivisection," in pricking his own finger, (as he presumably did to obtain the blood) certainly did perform upon a living animal an "experiment calculated to give pain," there can be no reasonable doubt that, under 39 and 40 Vict., c. 77, s. 2, he rendered himself liable to a penalty of £50.—Ed.]

RAINFALL.

[1683]—I have on several occasions observed the phenomenon you mention at foot of page 301 of your issue of April 10. So far as my recollection serves, however, it does not "always" occur when rain is falling heavily, but generally in warm weather, and always in a thunder-shower, which last fact led me to infer that it was caused by electricity. And the explanation of the *modus operandi* (though it may be a totally erroneous one) I arrived at was that the drops of the shower being, presumably, electrified *similarly*, the dispersion of the particles was due to repulsion. Pray accept my sincere congratulations upon your success, and best wishes for its continuance. U. H.

TASTE.

[1684]—Permit me to submit a few notes on certain matters of taste. 1. It is preferable that two sides of a human face be symmetrical, and unlike Fig. 1.

Fig. 1.

Fig. 2.

2. It is preferable that two volutes of an Ionic capital be symmetrical, and unlike Fig. 2.

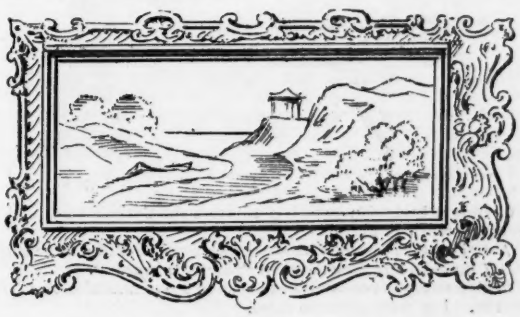


Fig. 3.

3. It is preferable that two sides of a picture-frame be symmetrical, and unlike Fig. 3.

4. It is preferable that two sides of the nave of a church be symmetrical, and unlike Fig. 4.

Fig. 4.

But 5. It is not preferable that the anterior and posterior parts of an animal be symmetrical, like Fig. 5. With every liberty of choice, the poet, the artist, and the herald, avoid exacting such symmetry alike in the centaur, the satyr, the mermaid, and the double-headed eagle.

Fig. 5.

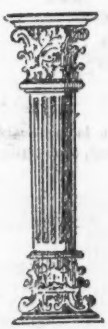


Fig. 6.

6. Only a barbarian architect reverses the Corinthian capital to form a base. See Fig. 6.

7. Symmetry is avoided between the extremities of a large ship.* Fig. 7 is unlike any type that the writer ever heard of.

8. Symmetry is not aimed at between the extremities of a large church. Fig. 8 shows three cases.

* [Yes, but for reasons connected with her propulsion, not for æsthetic ones.—Ed.]

Can any general conclusions be drawn from the above data?

One partial conclusion would be that symmetry should prevail among things on the same level: between two human shoulders, two knees, two feet, and between the two Ionic volutes that are

Fig. 7.

equally lifted up above the surface of the earth, while variation displays itself in things at different levels, between an elbow and a knee, a capital and base. We cover the four walls of room with similar paperhangings; they are at a uniform level. The floor and the ceiling at different levels, and no one thinks of carpeting the ceiling to match the carpeted floor.

Fig. 8.

A second conclusion would be that symmetry should only exist between parts of an object separated by a small dimension opposed to a long length; between these neighbouring eyes, cheeks, and shoulders whose distance is small compared to the length from head to foot.

This generalisation would equally apply to the man recumbent and the man erect, and would include the ship and the church.

There is an explanation on the ground of fitness and utility. A symmetrical pair of legs are good for walking, a symmetrical pair of paddles for propulsion; but this does not apply to the church or the picture-frame, inasmuch as they are not locomotive.

Can the inquiry for a principle be carried any further? Quite easily, though it be dropped for the present.

An Old Draughtsman.

TANDEM TRICYCLES.

[1685]—The best tandem is, in my opinion, the Humber Tandem, particularly where the rider who sits behind has been a bicyclist; but some ladies object to the Humber Tandem.

The next machine I should mention in the order of merit, is the tandem made by the Surrey Machinist Company. Starley's tandem is lower in price, and is a thoroughly solid, well-made, and serviceable machine. John Browning.

[In a communication from Mr. Browning, which is about to appear, he promises to refer to the question of Collapsible Tricycles. —Ed.]

BEES AND THE COLOURS OF FLOWERS.

[1686]—I quite agree with G. W. Bulman's (1674) remarks concerning the preference which bees exhibit for different coloured flowers. As far as my observations have gone this spring, they show that bees prefer yellow and white to blue, visiting yellow crocus and neglecting adjacent blue ones; the same has been observed as regards hyacinths. I have had, all the winter through, a large number of violets in bloom, but on mild days when my bees have been out, I have never remarked more than a solitary bee on the blooms, although the bees were passing and repassing over the beds. Nemophila maculata (blue and white) is recommended as a useful honey-bearing plant; but my experience of last year has induced me not to plant any this year for my bees, as but little attention was paid to these flowers until most other flowers were gone, and only late blossoms of nemophila remained; so this spring I have confined myself to the sowing of yellow, white, and pink coloured flowers, such as Sweet Sultan, &c. In partial support of these views which I hold, paying at the same time all due respect to the work of such an able observer as Sir J. Lubbock, I would refer to an article in *Nature*, 1878, p. 334, where it is stated by T. Meehan:—"It seems to me that bees are not attracted to flowers by colour or fragrance merely, but that they are influenced by labour-saving ideas. . . . White varieties or scarlet varieties are all one to them, they can distinguish the species by other means than colour." F. W.

LETTERS RECEIVED AND SHORT ANSWERS.

W. J. W. The diagram is one which can be made with such ease by the student himself that it is really not worth while to go to the cost of engraving it.—M. VERBECK. I was unfortunately absent on that day.—SENEX. If you are dissatisfied with the hypothetical form of assertion as to the origin of organic life from inorganic matter, I will put it more strongly, and say that life *must* in the beginning have originated from inorganic matter. There is no *tertium quid* between this and miraculous separate individual creation, which, to employ your own words, assuredly "is not science, but childish guessing." I cannot follow you in your confusion between the relative and absolute ages of members of the solar system. A Nubian girl is a woman at twelve, and an old woman at thirty; an Eskimo is seventeen or eighteen before she arrives at womanhood.—W. W. STRICKLAND. Cervantes was alluding to the myth, given by Pliny, that the beaver when pursued for its "castoreum" (anciently so much valued in medicine), bit off the parts containing it, as its hunters then ceased to follow it. The absurdity of this is evidenced by the fact that the female beaver also secretes castoreum.—COLONEL HERSCHEL. You are curiously mistaken, as you would yourself admit could you read the letters of other correspondents. Assuredly I have never gone out of my way to assail "the Department." Any remarks which have appeared in these columns have been made in connection with publications sent to me (presumably for *honest* criticism) having more or less direct reference to it. "The Truth," says the vulgar old proverb, "may be blamed, but it can never be shamed." The way in which the National Exchequer is plundered in the locality referred to is at once pitiable and shameful. How long is it since the Committee of Public Accounts in the House of Commons denounced the "grave irregularities" in the expenditure there?—COMMENTATOR further points out the extraordinary diversity of conditions under which life exists, even on and beneath the earth's surface. As to the moon's age, her relative age is, of course, meant. See conclusion of reply to "Senex" above; also the previous one on page 314.—DR. LEWINS. I must ask you kindly to accept my reply on page 334, as my reason for the non-insertion of the fresh summary of arguments for Hylo-Noësis, with which you have favoured me.—W. CAVE THOMAS. Many thanks. I gravely doubt, though, if I shall be personally able to utilise it.—OWEN MARCHANT. A little too much like an advertisement.—JOHN H. RAFFETY. Received with thanks.—PAUL DEMAS. The hypothesis propounded in the cutting you send scarcely comes under the head of a paradox; inasmuch as, theoretically, the tides must act as a species of brake upon the earth rotating within them. Whether, though, as asserted, the speed of the earth's rotation is actually sensibly lessening is open to the very gravest doubt.—SOCIETY OF ARTS. Received with thanks.—A. KARÓLY. As your MS. was unaccompanied by the stamped and directed envelope needed (according to our inexorable rule) to ensure its return, it was, I grieve to say, consigned, with fifty others, to the waste-paper basket.—J. R. TAYLOR. Delayed through being addressed to the Conductor, instead of to the Publishers.—PLANET. I regret that I am ignorant how many American editions Newcomb's "Astronomy" has run through. Messrs. Macmillan are now publishing the second English one. With reference to your second query, the earth *must* be more rigid than a globe of glass of the same dimensions; in fact, save for certain limited areas of fusion, must be solid to her centre. These fluid or viscous patches must be relatively near the surface. Probably, at any given depth, the rock or other material is at the melting point equivalent to the pressure there; so that, if that pressure were removed, liquefaction would take place.—ALEX. MACKIE. What is the quotient of infinity by 4, by 32, or by 100,000?—MRS. NICHOLSON asks if Mr. Mattieu Williams can suggest any means of rectifying the acidity of home-made ginger wine? The delay in the despatch of the number had its origin in your addressing the editor instead of the publishers.—EDMUND MITCHELL. I have to thank you for your offer, but there are no vacancies on the staff of this journal; and we are inundated with voluntary matter as it is. On receipt of a stamped and directed envelope, your testimonials shall be returned.—WILLIAM WINTER. The author is in the United States.—N. Delighted to find that I have been able to help you.—PUZZLED. See reply to Alex. Mackie above.—F. W. H. You fall far short of real and legitimate idealism. Destroy your mind, says the Berkeleyan, and the Universe ceases to exist for you. Destroy A's mind, B's mind, C's mind, and it ceases to exist for them—and so on. Destroy *all* mind, and an objective universe ceases to exist altogether!—WILLIAM WALLACE. Will be sent to America.—A SUBSCRIBER. I have not the slightest idea where Morrell's Ash-closet is procurable.—MISS ADA BALLIN desires to thank Miss Rosalind Cloutte for her interesting story (p. 335), and to invite other properly-authenticated illustrations bearing on the subject-matter of her articles.

Miscellanea.

WE learn that our esteemed contributor, Miss Ada Ballin, is preparing an English edition of M. James Darmertcher's new work, "The Mahdi;" to be published shortly by Mr. Fisher Unwin. The interest of its subject in the present juncture scarcely needs insisting on.

DURING 1884 the imports of frozen meat amounted to the enormous quantity of 619,324 sheep and 115,377 quarters of beef. Most of these supplies arrived in "magnificent condition," but in some instances great deterioration had taken place during the voyage, involving heavy loss to the importers, and showing the great value of trustworthy refrigerating machinery.

ON the 10th inst. the Wigan Tramways Company sold the whole of its remaining stock of horses. These lines have for the last three years been worked jointly by steam and horse-power, and it is through the undeniable economy shown by the past three years' working by steam as against horses that the above resolution was passed. The engines exclusively used on the system are the Wilkinson type.

MESSRS. SAMPSON LOW & Co. announce that during the present month they will publish:—"Under the Rays of the Aurora Borealis, in the Land of the Lapps and Kvæns," an original work by Dr. Sophus Tromholt, edited by Mr. Carl Siewers. The work will contain a map, chromo-lithographs, and 150 views, portraits, diagrams, &c., from photographs and drawings by the author, including numerous illustrations of the Aurora Borealis.

THE French authorities in Cochin China have erected overhead wires across the river Mekong, posts 165ft. high having been put up on each side of the river, at a spot where the width is 2,560ft., and from these silicious bronze wires—one ·04in., and the other ·055 in. in diameter—are suspended across the stream. Over a tributary of the river another similar connection has been made 1,670ft. span, and more than 114ft. above flood water. The former of these is a span of 0·46 of a mile.

ANOTHER serious attempt has, we hear, been made to concentrate and utilise existing knowledge of wind and weather-currents, and the influence of the moon thereon, so as to found some scientific rules for a definite weather guide. The work will be issued in a few days by Messrs. Baillière, Tindall, & Cox, under the title of "The Moon and the Weather," the author being Mr. W. L. Browne, of St. Petersburg. It remains to be seen whether he will be more successful than his predecessors in the same field.

A LARGE map of Egypt and the Soudan, printed in colours, will, we hear, be issued with Part I. of "Egypt: Descriptive, Historical, and Picturesque," to be published by Messrs. Cassell & Company on the 27th inst. This map has been constructed by Mr. F. Weller, F.R.G.S., from the latest authorities, including the Admiralty and War Office charts and maps, and also from private information, special attention being given to the districts which are at present the scene of British military operations.

THE Western Union Telegraph Company dispose of 100 tons of old telegraph wire every year. The average life of a wire is from five to seven years, being less along the sea coast and borders of the great lakes than it is inland. The wire now used for telegraph purposes is generally galvanised iron No. 8, measuring about 16 ft. to the pound. The first telephone wires were No. 16, or about 1·20 in. in diameter. They were soon depreciated by rust and broken by ice and slight accidents, so that such fine wires were abandoned after the failures of the first winter.—*Engineering*.

GAS AS AN ECONOMISER OF COAL.—The exhaustion of the coal supplies of the country has been the subject of discussion in some of the Manchester dailies between Mr. Ellis Lever, of Bowden, Cheshire, and Mr. Thomas Newbigging, the president-elect of the Gas Institute. Mr. Lever laments the waste in getting the coal and in using it when got, whilst Mr. Newbigging is of opinion that the coal supply is not so close upon the point of exhaustion as many people suppose. Replying to this letter, Mr. Lever offers a sum of £20 for the best paper or essay to be read at the forthcoming meeting of the Gas Institute in Manchester, on the subject of "Economising coal by the more extended or general use of gas for domestic and manufacturing purposes, and for the generation of steam." Mr. Newbigging, in his official capacity, has accepted this offer. The subject is one of vast importance, and must be carefully considered, and we question whether a premium of £20 is a sufficient inducement to the preparation of an exhaustive paper. We shall, therefore, gladly supplement that sum by £30; or, alternatively, we shall give a premium of £50 for the best paper, and the £20 offered by Mr. Lever might then be awarded as a second prize.—*Gas and Water*.

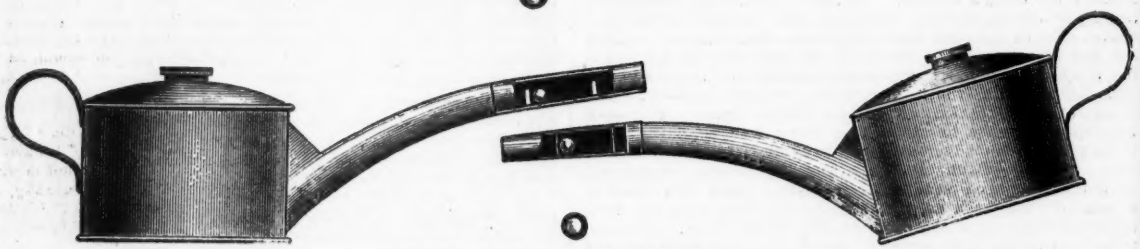
Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge being a popular magazine) than is accorded by the most excellent trade journals.

"AUTOMATIC GOVERNOR TIP" FOR OIL-CAN.

[Patent No. 7,941. 1884.]—Oil consumers find that the present oil-can, with its spout terminating in a fine orifice, is troublesome, because, after new cans have been in use a few days that these fine terminals become made up and are broken away, until an outlet is made four or five times the area of that intended. This means a very large percentage of waste in oil. The Automatic Governor Tip, patented by Jas. Pearson, of Ashton-on-Ribble, near Preston, is intended to remedy this. The Patent Governor Tip gives an orifice for oil delivery three-sixteenths of an inch in diameter, while the orifice for oil supply is only equal to one-thirty-second of an inch in diameter. As will be seen from the above drawings, the spout is only closed during the operation of oiling. When the can is at rest the spout is open. The tip is made in strong brass, the ball being steel and highly polished. Any can having this simple attachment will deliver either a drop by drop or a needle-like supply. It is stated that by the use of this Governor Tip over 30 per cent. of oil is saved, and the wear and tear and repair accounts are reduced at least 50 per cent., while within a short distance of Preston within a few weeks 30,000 of these cans have been disposed of.

Section showing open Spout.



CAN WHEN NOT IN USE. Section showing orifice for Oil delivery. CAN IN USE.

Size of orifice at spout end, 3-16 in. Size of orifice for oil delivery, 1-32 in.

INHALER.

[Patent No. 775. 1884.]—Dr. Stoker has patented this simple and useful contrivance for the treatment of chest and throat diseases. It is characterised by its cheapness, simplicity, portability, and facility for attaching it to the vessel containing the inhalation.

It consists of a distensible cap, A, provided with a small inlet tube, C, of glass or other material, and a mouthpiece, B. The cap is fitted over the mouth of the vessel containing the medicated vapour, C being downwards. The vapour may then be inhaled through B. Mr. John W. Dyas, of 16, Victoria-road, Hackney Wick, is entrusted with the manufacture of the article.

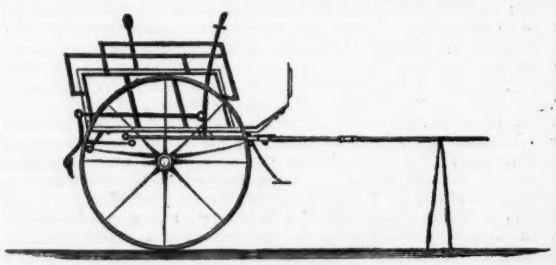
LAWN EDGE-CUTTER.

[Patent No. 5,949. 1884.]—Mr. J. E. Ransome, of the well-known firm of Ransomes, Sims, & Jefferies (Limited), have introduced their new Patent Edge Cutter, to meet the demand for a light, simple, strong, and useful substitute for hand shears, for trimming the edges of lawns, &c. It will be seen from the illustration that revolving with the roller is a series of four knives, while a fifth is fixed vertically. As each revolving blade passes the fixed, an automatic pair of shears or scissors is formed, and the grass, &c., which intervenes, is cut off. Being light in weight and having two handles it can be guided with ease either in a straight line or round the edges of flower beds, &c.

The depth of cut can be varied to suit the depth of the edge by simply tilting the conical roller more or less. It is said that, after a little practice, a man can trim the edges of his lawn as fast as he can walk.

BRAKES FOR VEHICLES.

Two-wheel vehicles have always presented great difficulties to the successful application of a brake, the leading one being that of throwing too much weight on the horse. A glance at any two-wheel cart in motion will readily show how this is, as, wherever pressure or friction is applied, weight must be thrown on the



shafts. In Mr. Casson's brake, which will be shown at the Inventions Exhibition, this difficulty is overcome by a simple arrangement whereby the centre of gravity of the load is shifted behind the axle a few inches when the brake is applied. To effect this, Mr. Casson connects the back end of the shafts to the rolling-bar of the brake, so that when the brake is applied the back ends of the shafts are risen some seven or eight inches, and weight taken off the ends on the horse. It is generally supposed that the shaft is a lever, moving round a fulcrum near the foot-board, and that when the back ends are risen the front must be depressed. This would be the case were the fulcrum fixed to the ground, but being a

movable quantity, the effect of raising the hind ends is to tilt the body backwards, and this accomplishes three important things—first, when going down hill, weight is taken off the horse; second, the brake is applied to the tyres; and, lastly, the body is placed nearly horizontal—a great comfort to the occupants.

Mr. Casson was awarded the first prize for this arrangement at a brake competition, and one brake has stood the test of five years' constant usage on the Malvern hills.

As the moving parts are all simple pivots the friction is small. The brake blocks are indiarubber, which, besides being noiseless, holds a good grip on the wheels. The brake can be fitted to almost any cart.

Our Whist Column.

By Five of Clubs.

NOTE ON LEADING.

A POINT in whist which is by no means sufficiently dwelt upon in the books is the distinction between the original first lead, and the first lead in a suit after play has begun. Pole, for instance, in his rhymed instructions (which are full of doubtful matter), says that "there is necessity the strongest that your first lead be from the suit that's longest." Now this rule is in reality only true generally of the original first lead. It may be compared in this respect with another rule which equally leads weak players astray—the rule that your first discard should be from your shortest suit. Indeed, there is a noteworthy parallelism between the lead and the discard in this respect. The rule for either which is good when you are certainly strong, is not good when you are doubtful about your strength, and is the reverse of good when you are certainly weak. You may discard so as to unguard an honour if you and your partner are very strong, or even discard a singleton, rather than fail to show your partner your short suit; but when you are in doubt about your combined strength, though you would still, as a rule, discard from your shortest suit, you would not do so if it obliged you to discard a singleton or the only guard of a king; and when you are weak you discard from your best protected (which is usually your longest) suit, without hesitation. Similarly with the lead. As original leader you are in doubt usually about the combined strength of your hand and your partner's; under these conditions you need very seldom depart from the rule of leading your longest suit. If your partner is strong, then even though you are weak, it is more important that he should know which is your longest suit, and therefore which suits are the enemy's, than that you should lead from shorter suits in which you may be more likely to make tricks. But after the play is opened, and you can form an idea about the position of the strong cards, you may find that there is not any good reason for showing your partner the chief component of your hand. When you find he is weak and you are weak yourself, it is idle to lead from your longest suit. Leading from length is primarily intended as a step toward bringing in that suit. When you know that neither you nor your partner can hope to bring in a long suit, it is idle to play as if a forward game could profit you. Yet we sometimes see a player who thinks by no means meanly of his own skill lead from a suit of five small cards, when it is absolutely certain that he cannot get a lead to bring in the suit, even though it should chance to be established.

And here I would remark that the objection urged by Matthews originally, and later by Pembridge, against leading from a long, weak suit, is too general. If you have no cards of re-entry—that is, no good cards in your short suits, and no chance of a ruff—it is manifestly folly to lead from a suit of five small cards, except as an original first lead when your object is to avoid misleading your partner as to the numerical constitution of your hand. But if you have a winning card or so outside your long, weak suit, you often show your partner how he may bring in the tail end of that suit by helping you to clear it, and throwing the lead into your hands. Or, in such cases, though you may not successfully bring in the long cards in the suit, you may use them to help your partner by forcing the enemy. It is only, in my judgment, when you have no reasonable chance of getting another lead, that opening a long, weak suit deserves the ridicule thrown on it by Pembridge, or that it can be regarded (as it is by Matthews) as more likely to do harm than opening a short but stronger suit. Often in opening a short suit in which you have a good card or two you play the enemy's game most effectively, giving up just so much of your control over that suit as to enable the enemy to bring it in and make their small cards in it to the bitter end.

When, however, both you and your partner are obviously weak, it is better in leading for the first time, to lead through strength or up to weakness, than to open a long weak suit. Your partner should know how to distinguish a lead made under such circumstances from the usual lead, just as a discard, when strength is declared against you, is interpreted the reverse way from a natural discard, your partner being usually able to recognise the suit you discard from as your best-protected or longest suit, so usually a first lead, when the enemy have shown great strength, should be interpreted differently from an ordinary lead. When we consider, indeed, how often in dummy play we see the weak hands saved either by a cross-ruff, or by play directly aimed at making good cards as quickly and simply as possible, we recognise the necessity which often arises in ordinary play for at once meeting declared strength of the enemy's by departing from the usual tactics.

Even under such conditions, however, a singleton lead is scarcely ever sound. If you have a singleton (Pembridge remarks well that not holding a singleton is a sound reason for not leading one), you and your partner may have a fair chance of a cross-ruff, but the very best course for losing that chance is to lead your singleton. If you do, you are apt to begin ruffing before your partner is ready to go on with the cross-ruff; the enemy immediately lead out trumps; and your chance is gone. Now if your partner like yourself is short in a suit, the chance of a cross-ruff comes from the circumstance that the strong adversaries will show each other their strong suits, one clearing out your short suit, the other clearing out your partner's; and then, when either leads, you and your partner get in your see-saw tactics successfully, make four or five tricks by ruffing, and are safe, the enemy's trumps falling together afterward. By a singleton lead you are very apt to lose this chance.

And here let me remark on the importance of care in deciding whether you should return your partner's lead at the first opportunity, or show your own suit. Cavendish is far from giving satisfactory advice on this point, about as critical a point of Whist strategy as there is. He says: "It is in most cases advisable to open your strong suit, when you possess *great* strength in any suit, for you open such suit to advantage; but with weak or only moderately strong suits, which you open to a disadvantage, you would, as a rule, do better to return your partner's original lead." But a partner who interprets this rule literally and refrains from showing his best suit unless he has great strength in it, is apt seriously to impair the strategy of the hand, by leaving his partner uninformed respecting the position of the strong suits. If I have a strong suit, it is doubtless advantageous, so far as that suit is concerned, to have it returned, but it is more important, *usually*, so far as the play of the hand is concerned, to know how the other suits lie: if my partner returns my suit at once, I may remain longer in doubt on this point than is safe. But further, much depends on the evidence which the first lead may give respecting the strength of the suit led from. If a long suit, though but moderately strong, seems likely to be at least as strong as partner's suit, it is better to lead one's own suit than to return his. Or if both hands seem weak, it may be better to lead through strength on the left or up to weakness on the right, than either to return partner's suit or to lead one's own. In fact, a whole chapter might be written on the question which Cavendish dismisses in half a dozen lines.

A. Neilson.—Certainly *not*. Honours which do not count in winning a game, can assuredly not be dragged in, *ab extrâ*, to diminish the number of points.

"Denique non omnes eadem mirantur amantque."—Before the very languid interest taken by the general public in the so-called American leads altogether fizzles out, it would seem an opportune moment to define two other equally important matters of the same class, as yet out in the cold. Thanks to the improved edition of Clay, for some years we have been in possession of "the discard of uniformity," and the combined efforts of "N. B. T." and "Cavendish" in the *Field* have recently provided us with "the card of uniformity;" unfortunately, though doubtless satisfactory up to a certain point, these inventions are scarcely strong enough to run alone; but if the misdirected ingenuity which devised them would in addition kindly formulate "the hand of uniformity" and "the score of uniformity," with four such legs, the *corpus*—or rather *cadaver*—of Whist would be complete.—Pembridge.

Range of the Human Voice.—There are in the human voice about nine perfect tones, but 17,592,186,044,415 different sounds. Thus fourteen direct muscles, alone or together, produce 16,383; thirty indirect muscles produce 173,741,823; and all in co-operation produce the large total given above, independently of different degrees of intensity.

Our Chess Column.

By MEPHISTO.

GAME PLAYED IN THE HANDICAP TOURNAMENT NOW IN PROGRESS AT THE CITY CHESS CLUB.

Remove Black's King's Bishop's Pawn.

White. W. J. Chappell.	Black. J. Gunsberg.	White. W. J. Chappell.	Black. J. Gunsberg.
1. P to K4	P to Q3	16. KR to B sq. (*h*)	B to Kt6
2. P to Q4	Kt to KB3	17. K to Kt sq.!	B to B5
3. B to Q3 (*a*)	Kt to B3	18. Kt to Kt sq. (*j*)	B to K3
4. Kt to KB3	P to K4	19. P to KKt3	KR to Q sq. (*k*)
5. P × P	P × P	20. B to Q5	P to B3
6. P to QR3 (*b*)	B to K2	21. P × B (*l*)	P × B
7. B to K3	Kt to KKt5 (*c*)	22. P × KP	Q × P
8. Q to K2	Castles	23. P × P	R × P
9. P to KR3 (*d*)	Kt × B	24. Q to KB3	R to Kt4 (*m*)
10. Q × Kt	Kt to Q5 (*e*)	25. P to Kt3	R to QB sq.
		26. KR to K sq.	Q to QB4 (*n*)

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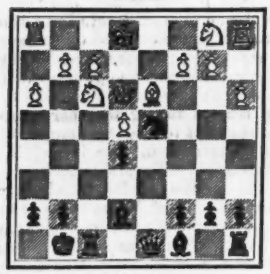

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11. QKt to Q2	B to QB4	27. Q to Q3	B to B5
12. B to B4 (ch)	K to R sq.	28. Q to Q6 (*o*)	Q to B4
13. Q to Q3	Kt × Kt	29. K to Kt2 (*p*)	
14. Kt × Kt	Q to B3 (*f*)	Resigns.	
15. Castles QR (*g*)	B × BP		

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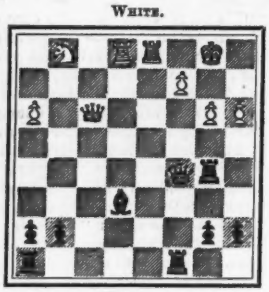

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NOTES.

(*a*) 3. Kt to QB3 deserves a slight preference.

(*b*) Weak, as the move serves no purpose, and therefore loses time.

(*c*) This gains important time and gives greater freedom of action to Black's pieces. No doubt White intended playing P to KR3 on his next move.

(*d*) Now this move is of no service whatever. Black has attained his object—he has gained time for Castling.

(*e*) The position shows the vast importance of proper development. Although ten moves only have been made, Black has turned the tables on White, as if White were the second player. The move Kt to Q5 gives Black a grip on White's position. It is a move likely to be effective in a game at odds. If White replies with 11. Kt × Kt, P × Kt. 12. Q to K2, B to Q3, followed if White Castles KR by Q to Kt4, Black having then both his B's and his Q and R in fine play. On the other hand, should White take the KP the following might result:—11. Kt × P, B to QB4. 12. B to B4 (ch), B to K3 (or *a*). 13. Q to Q2, Q to B3. 14. Kt to Q7, Q to Kt3, with a fine attack. Or (*a*) 12. K to R sq. 13. Q to Q2, Q to K2, with a good game. Kt × P may give rise to many variations of play, the probability being that Black would maintain his attack against most moves at White's disposal.

(*f*) This prevents White from Castling either side, for if Castles KR, then Black might win a Pawn by B × KRP. If Castles QR, then the KBP falls. Black also threatens Q to QKt3 or KKt3, both being effective moves.

(*g*) White by giving up the KBP reaches the much-desired haven of refuge for his King, and likewise obtains an attack.

(*h*) White has fully atoned for his failings in the opening. This move is difficult to meet. If Black plays B to KB4, White's answer of 17. Q to Q5 would be extremely inconvenient, for after B to Q3 is done by Black, White could still play 18. Kt × KP with the better game.

(*j*) This again is weak play against the principles of development, and giving Black time, of which he makes very good use. In positions where, as is the case in Black's game, a weakness exists (consisting of the awkward block by his own QB) nothing but vigorous play will lead to an advantage. Besides other moves, White might have played 18. Kt × P, Q × Kt. 19. P to Kt3, and Black has no good move for his unhappy QB, for if the QB × RP, then after 20. R × B White will be able to bring both his R's to support an attack on the R's file, as Black cannot reply with R × R, for after 21. P × R Black's B would be in danger of being caught.

(*k*) It may be of importance that in a possible contingency White should not be able to play R × R (ch). Black relied upon R to Q sq. to save his piece, for if now 20. Q to K2, R × R (ch), compelling either 21. Q × R, B × B or 21. R × R, which sets the Black KB free to take the P.

(*l*) Instead of this, 21. P to QB4 at first sight seems a better move, but "look ere you leap," will save many a P if 21. P to QB4, P × B. 22. BP × P, R × P! as the KP cannot retake on account of B to B4.

(*m*) Seizing the favourable opportunity for a counter attack, which White might, perhaps, have resisted with more success by 25. P to B3.

(*n*) White cannot take the B on account of Q × P (ch) followed by R × P. If Black had played Q to KB4, White would have replied with 27. Q to K4, Q × Q. 28. R × Q, B to B4. 29. R to QB4 &c.

(*o*) 28. Q to Q4 was much better, Black could not then have taken the RP, on account of Q × B! threatening mate.

(*p*) At this stage the game was adjourned at White's request. Subsequently White resigned. Black wins at once by B × P; White cannot retake, for if 30. P × B, Q to B7 (ch). 31. K to R sq., Q to B6 (ch), and mates in two moves. Duration of the game three-and-a-half hours.

SOLUTIONS.

END GAME by B. HORWITZ, p. 316.

1. R to Kt3 (ch)	K to R3	2. B to K3 (ch)	K to R4
3. R to Kt5 (ch)	K to R3	4. R to Kt8 (ch)	K to R4
5. Kt to B4 (ch)	K to R3	6. Kt to K2 (ch)	K to R4
7. Kt to Kt3 (ch)	K to R5	8. Kt to B5 (ch)	K to R4
9. R to Kt5 mate			

PROBLEM BY C. PRADIGNAT.

1. Q to Kt5	B moves	2. R to QB4, &c.
1.	B × R	2. R × B, &c.
1.	Kt to Qsq	2. Q × B (ch), &c.
1.	P to Q5	2. R × P (ch), &c.

and mate's next move.

W.—Solution correct.

Mr. R. A. Proctor, having paid a brief visit to New Orleans, has also visited the famous American Chess Club at that city, and has played some interesting games with some of the club experts. We regret to announce that the Sixth American Chess Congress has been indefinitely postponed.

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